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Child Behavior, Animal Behavior,
and Problems of Aging

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CHANGES IN INTELLECT WITH AGE: I. LONGITUDINAL STUDY OF WECHSLER-BELLEVUE SCORES*

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A. INTRODUCTION

Shock (20) in his review of the literature on the effect of aging on intelligence stated, "There can be no doubt that average raw scores attained on intelligence type tests diminish with increasing age. The decline in average scores begins in the twenties and continues at an increasing rate up to age 60. The extent and the nature of the decline in performance beyond age 60 is still uncertain."

Studies on the changes in intellectual achievement of older people utilizing stratified samples (representative studies are: 2, 4, 6, 9, 10, 12, 14, 15, 23) in general have confirmed Shock's thesis; although there have been suggestions that some verbal functions, e.g. Vocabulary (6, 9, 17, 21), did not show the same decline with advancing age as performance tests.

Dennis (7), Shock (20), and Eysenck (8) among others have pointed out the desirability of the longitudinal method over the cross sectional in studying intellectual changes with age. There have been a few longitudinal studies among the older age groups. Three of these studies suggested doubt of Shock's generalizations. Bayley and Oden (1) in a longitudinal study of intellectually gifted adults reported significant gains on retest, after a period of 10 to 12 years, on tests of synonyms, antonyms, and analogies. Owens (18) gave the Army Alpha to a group of college graduates who had taken the test about 31 years previously. He reported increases in scores on the second testing. He expressed doubts that age, per se, had a differential effect on the variations in achievement between his most talented males and those who were less talented. Jarvik, Kallman, and Falek (13) gave four of the Wechsler subtests (Digit Symbol, Block Design, Digit Span, and Similarities) and the Vocabulary test of List I of the 1916 Stanford-Binet to subjects having an average chronological age of 67.5 years. On retest about eight years later only Digit Symbol showed a significant decline. The subjects in all these studies represented that portion of the intellectual distribution that was above the mean.

* Received in the Editorial Office on February 1, 1963, and given prior publication in accordance with our policy regarding manuscripts on the subject of aging.

The data reported in this paper are a segment of a larger study of some of the intellectual changes in older males. This portion of the study measures the changes in intellectual achievement uncovered by retesting aged subjects (who included a wide range of intellectual abilities) after an average interval of 8.65 years.

B. SUBJECTS

The sample of subjects was drawn from the 197 males who were resident at the Bath Veterans Administration facility and had previously been examined with all eleven subtests of the Wechsler-Bellevue Form I at least five years earlier. They were all scheduled for re-examination. Eleven men had deteriorated to either a mental or physical condition in which they were untestable. Two were unable to complete some of the Performance subtests because of visual difficulties. The subjects reported on in this study are the remaining 184 members. The time between first testing and second testing varied from five to fourteen years with a mean of 8.65 years. The distribution was rather asymmetrical having a primary cluster of some 76 per cent of the time intervals between 9 and 11 years. The mean chronological age at first testing was 56.32 with an *SD* of 7.28. At the second testing the mean age was 64.97 with an *SD* of 7.99 years.

The Wechsler-Bellevue measures a variety of intellectual activities. One of its disadvantages as an objective test is the need to rely on the judgment of the examiner for subtests such as Vocabulary, Comprehension, Similarities, and to a lesser degree on Information. While there probably is little variability in the judgments of any one experienced examiner there may be considerable variability between the judgments of several examiners if the responses are not "classical." Since the first examinations and the second examinations were conducted and scored by different examiners any biases of the examiners might have effected the results. If biases existed they could have operated to unknown degrees on each subtest. To compensate for possible biases, all second examinations for the sample were reviewed for Comprehension, Vocabulary, Information, and Similarities subtests by another psychologist. Where discrepancies in scoring occurred between the judgment of the examiner and the reviewer the higher score value for the items was used.

Berkowitz (2) has described the educational and occupational background of the larger population of 1233 of whom the 197 were a sample. The distributions of the *IQ*, the educational, and the occupational background of this sample were closely similar to those of the larger population. This being true we believed that there were no important biases in the determination of which men died or migrated to other communities.

C. RESULTS

The scores reported for the 11 subtests are raw scores in units described by Wechsler (22). Using his tables for each subject the Verbal, Performance, and Full Scale Scores were computed. These were then converted to *IQ* scores. The distribution of the Full Scale *IQ*s for the 18+ subjects on the

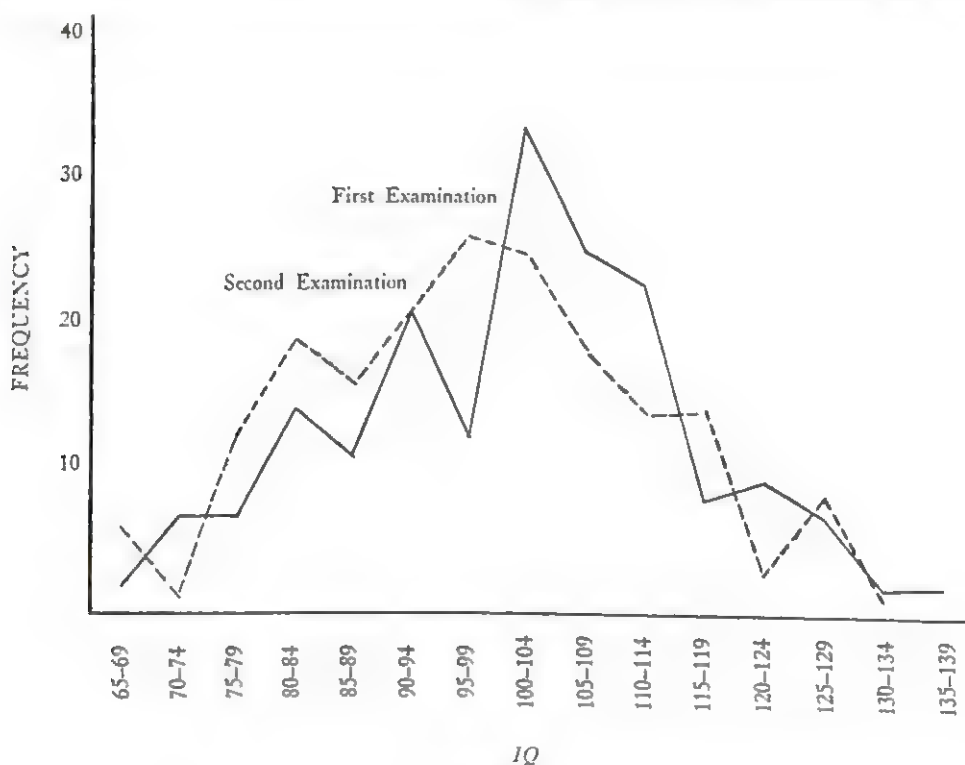


FIGURE 1
IQ DISTRIBUTION ON THE FIRST AND SECOND EXAMINATION

first and second examination is shown in Figure 1. On the first examination the total sample had a mean Full Scale *IQ* of 100.72 with an *SD* of 14.89. At the second testing the mean had fallen to 97.71 with an *SD* of 14.52. For all three *IQ* variables, for all three composite scaled score variables and for all 11 subtests the sample showed a significant decline in achievement from the first examination to the second (Table 1). It should be noted that the mean and standard deviation of this group was very similar to the mean and standard deviation of Wechsler's standardizing population.

To determine the effect of original achievement on changes in scores on the various subtests, the subjects were divided into six groups, organized in

TABLE 1
MEANS AND STANDARD DEVIATIONS FOR FIRST AND SECOND EXAMINATION

	First examination		Second examination		Diff.
	<i>M</i>	σ	<i>M</i>	σ	
Full Scale <i>IQ</i>	100.72	14.89	97.71	14.52	3.01*
Verbal <i>IQ</i>	100.95	15.05	98.64	14.37	2.31*
Performance <i>IQ</i>	101.73	13.56	100.66	13.51	1.07*
Full Scale Score	76.63	25.28	66.91	25.17	9.72*
Verbal Score	42.08	14.70	37.59	14.48	4.49*
Performance Score	34.55	12.70	29.32	12.65	5.23*
Comprehension	9.83	3.77	9.09	3.53	.74*
Digit Span	9.70	2.44	9.12	2.10	.58*
Arithmetic	6.17	2.92	5.47	3.04	.70*
Similarities	8.82	5.17	7.32	4.93	1.50*
Picture Arrangement	6.44	3.49	5.52	3.56	.92*
Picture Completion	9.15	2.84	8.67	3.03	.48*
Block Design	13.32	7.96	10.07	7.40	3.25*
Object Assembly	15.60	4.62	13.58	4.81	2.02*
Digit Symbol	22.22	11.58	17.93	9.82	4.29*
Information	14.13	4.95	13.14	5.41	.99*
Vocabulary	21.93	8.35	19.12	8.08	2.81*
Age	56.33	7.28	64.98	8.00	8.65*

* $p < .05$.

descending order of Full Scale *IQ* on the first examination. Group A was the 26 subjects with the highest *IQ*s. The next 26 subjects were Group B. Group C and D were the two middle groups of 40 subjects each. Groups E and F completed the progression with E being the 26 subjects with the next to lowest and Group F being the 26 subjects with the lowest *IQ*s.

Since Groups A, B, E, and F were relatively small, Groups A and B were combined into a Group called AB, and Groups E and F were combined into a Group called EF. The significance of the differences between the means of the successive examinations for each group is summarized in Table 2.¹ For every group for each subtest (with the exception of Digit Span for Group F) the mean raw score was numerically, but not always significantly, smaller on the retest than on the original testing. It was therefore to be expected that all Full Scale Scores, Verbal Scores, and Performance Scores would be significantly smaller on the retest, and they were. Among the Verbal subtests only Vocabulary showed retest scores in every group that were consistently significant. For Similarities the three highest *IQ* groups

¹ A set of tables showing all means, standard deviations, and correlations cited are available on request from the senior author.

Copies of the tables have also been deposited with the ADI Auxiliary Publications Project, Photoduplication Service, Library of Congress, Washington 25, D.C. Cite Document number 7538 and remit \$2.50 for photoprints, or \$1.75 for 35 mm. microfilm. Advance payment is required. Make checks or money orders payable to: Chief, Photoduplication Service, Library of Congress.

TABLE 2
SIGNIFICANCE OF DIFFERENCES BETWEEN THE MEANS ON THE FIRST AND SECOND
EXAMINATIONS FOR EACH GROUP^a

Variable	A	B	C	Group		F	AB	EF
				D	E			
Full Scale <i>IQ</i>	S	S	S	S	N	N	S	N
Verbal <i>IQ</i>	S	S	S	S	N	N	S	N
Performance <i>IQ</i>	N	N	N	N	N	N	S	N
Full Scale Score	S	S	S	S	S	S	S	S
Verbal Score	S	S	S	S	S	S	S	S
Performance Score	S	S	S	S	S	S	S	S
Comprehension	S	N	N	N	N	N	S	N
Digit Span	S	N	S	S	N	N	S	N
Arithmetic	N	N	S	S	S	N	S	S
Similarities	S	S	S	N	N	S	S	N
Picture Arrangement	S	N	S	N	S	N	N	S
Picture Completion	N	N	N	S	N	N	N	N
Block Design	S	S	S	S	N	S	S	S
Object Assembly	S	S	S	S	S	N	S	S
Digit Symbol	S	S	S	S	S	N	S	N
Information	N	S	N	S	S	S	N	S
Vocabulary	S	S	S	S	S	S	S	S

^a S = statistically significant.

N = not statistically significant.

Note: The criterion of significance adopted throughout the paper is the 5 per cent level.

plus the lowest *IQ* group (Group F) showed mean decreases between examinations that were significant. The mean decrease of the two highest *IQ* groups combined (AB) was significant while that of the two lowest groups combined (EF) was not. On the Information subtest, the three lowest *IQ* groups plus Group B showed significant mean decreases. The mean decrease of Group EF was significant while that of Group AB was not. On the Comprehension subtest significant mean decrement seemed to occur predominantly among those with the highest original achievement. For Digit Span and Arithmetic, the mean decrement between tests was significant for Group AB. For Arithmetic it was also significant for Group EF.

Among the Performance subtests, Block Design, Object Assembly, and Digit Symbol showed significant patterns of decrement between examinations, among the highest 70 per cent of the *IQ* range (Groups A-D). For Picture Arrangement and Picture Completion it was difficult to determine whether the mean decreases on retest were more significant at the high or low end of the *IQ* continuum.

Another approach to the relationship between original achievement and performance on any subtest is the Pearson product moment correlation between *IQ* and scores on any subtest; and *IQ* and change in score between examinations.

The correlation between Full Scale *IQ* on the first examination and Full Scale *IQ* on the second examination for the entire sample was $+.925$. The correlations between Verbal *IQ* on first examination and second examination was $+.928$ while the corresponding correlation for Performance *IQ* was $+.859$. In general, there was a high and significant relationship between *IQ* and score on each subtest. The correlations between Verbal *IQ* and verbal tests were larger than the correlations between Performance *IQ* and performance tests. The correlations between Performance *IQ* and performance tests were larger than that between Performance *IQ* and verbal tests.

The correlations between Full Scale *IQ* and the scores on each subtest ranged between $+.619$ for Object Assembly to $+.833$ for Vocabulary. On the retest the correlations between Full Scale *IQ* and score on each subtest ranged from $+.648$ for Object Assembly to $+.865$ for Vocabulary. For any subtest there was very little change in correlation from the first examination to the second. The rank order correlation between the correlation coefficients for the first and second examinations was $+.81$. Similar relations were found between Verbal *IQ* and Performance *IQ*, and score on any subtest.

For the Verbal *IQ* and scores on all the subtests, the correlations on the first examination ranged from $+.405$ for Object Assembly to $+.881$ for Vocabulary. On the second examination the correlations ranged from $+.435$ for Object Assembly to $+.889$ for Vocabulary. The rank order correlation between the correlation coefficients for the first examination and second examination was $+.90$. For performance *IQ* and score on all 11 of the subtests the correlations on the first examination ranged from $+.517$ for Digit Span to $+.835$ for Block Design. On the second examination the correlations ranged from $+.525$ for Digit Span to $+.816$ for Block Design. The rank order correlations between the correlation coefficients for the first examination and the second examination was $+.96$.

Changes in scores between examinations (difference scores) were expressed as positive integers as follows: the changes in score were added to a base of 100 if the second score was larger than the first or subtracted from a base of 100 if the second score was less than the score on the first test. The resulting difference scores were correlated with the Full Scale *IQ*s by the Pearson product moment method. In general, for all subtests for all 184 subjects, the correlations are small and are predominantly negative. The only positive correlations were Picture Completion $+.047$ ($p > .05$) and Information $+.172$ ($p < .05$). A negative correlation expresses a decrease below 100 of the difference score magnitude as the *IQ* increases.

The correlations between the score on each subtest of the first examination

and the difference score on that subtest indicated that those who scored highest on each subtest tended to show the greatest absolute decline in score on the retest. The highest correlation of $-.546$ is for Digit Symbol. Significantly high negative correlations occurred for Digit Span, Comprehension, Similarities, Picture Arrangement, and Block Design. Object Assembly, Arithmetic, Picture Completion, and Vocabulary showed more modest but still significant correlations. The first examination score-difference score correlation for Information was not significantly different from zero.

Since the time between the first and second examination was not the same for all subjects a correlation between the interval between examinations (expressed in months) and the difference score between the two testings was computed. All the correlations, except that for Vocabulary ($+.028$), were negative. The correlations were small. The only significant correlations were Object Assembly ($-.232$), Block Design ($-.198$), and Information ($-.150$). There was then some tendency for the longest intervals between examinations to produce the greatest decrease in raw score. This tendency was poorly defined because of the narrow range of time intervals involved.

The correlations of chronological age with the scores on each subtest for each examination were, as they ought to have been, negative for each subtest. The older the person the lower were his subtest scores. The correlations were small, none being greater than $-.348$. The correlations for the performance scores were larger than those for the verbal subtests. The Correlations for Vocabulary, Information, and Digit Span were not significantly greater than zero.

A series of t tests were computed to determine whether the mean rate of change in the 11 subtest raw scores and the various scaled and IQ scores, all expressed as difference scores, differed significantly from group to group (Table 3). The significant differences between adjacent groups were most frequent for Digit Symbol and Digit Span. It was only when we compared disparate groups that significant differences appeared for Comprehension, Similarities, Information, and Block Design. For Vocabulary, Picture Completion, Picture Arrangement, Object Assembly, and Arithmetic, no significant differences appeared at all. It should be noted that for one subtest, Information, the difference score for a lower IQ group was greater than the difference score of a higher IQ group.

D. DISCUSSION

Decreases in some Performance scores were expected with advancing age (2, 5, 10, 12), but significant decreases in Vocabulary and Information were

at variance with the results of previously reported studies; both stratified and longitudinal. (1, 9, 10, 11, 12, 18). We, therefore, investigated a series of possible explanations for our results.

There was the possibility that on the retest many of the older men had reached a state of senility that seriously distorted the effects of normal aging. To determine this we made a series of evaluations. For example, if this were so, then change in scores for *all* subtests should be expected to show definite negative correlations with age. Based on the results of stratified samples (2, 10, 12) Block Design and Digit Symbol were considered most susceptible to decrement with advancing age. In this study age correlated $-.174$ ($p < .05$) with change in Block Design scores and $-.188$ ($p < .05$) with change in Digit Symbol scores. The correlations between age and change in scores between examinations were $-.267$ ($p < .05$) for Information and $-.143$ ($p > .05$) for Vocabulary. The most susceptible performance subtests were therefore not more associated with advancing age than were the allegedly least susceptible verbal subtests. The correlations between age and change in scores between examinations for such other subtests as Digit Span, Arithmetic, Similarities, Picture Arrangement, and Picture Completion were very close to zero but did have negative signs. A negative sign for the correlations was to be expected. The subjects were in advanced age groups and mean decrease in achievement, however slight, with advancing age, could be expected. The low values of the correlations however did not support a deterioration in achievement due to significant senility.

Botwinick and Birren (4) compared seniles with normals on the Wechsler-Bellevue. They reported that the Information scores of the senile patients showed a greater mean difference from the controls than the scores on Vocabulary. Since in our study decrement in the Information subtest showed the largest association with age we investigated its role as an indicator of abnormal deterioration in our sample. In our study for every group the mean difference score in Vocabulary from the first examination to the second was significant. Since above average *IQ* scores were not expected to occur among seniles and since our Group A in particular was definitely above average, it was pertinent that for the Vocabulary subtest no group had a mean difference score significantly larger or smaller than that of any other group. In contrast to this the mean difference scores for Information were in general less often significant than they were for Vocabulary. The mean of the difference scores between tests for Information was not significant for Group A. It was significant for Group B. It was significant for the three lowest *IQ* groups and for the two lowest groups combined.

This contrast between Information and Vocabulary changes was also indicated in a comparison of the relative changes in each of these subtests.² As we moved from Group A to Group F for the Information subtest, the absolute change in score became an increasing percentage of the original achievement (.42, 4.76, 6.07, 8.36, 18.36, 18.83). This suggested that decline in Information score achievement might be associated with original achievement. If equal absolute mean changes did in fact represent different percentage changes then those with the highest original *IQ* showed the greatest resistance to decline in Information with advancing age. For Vocabulary the absolute change in score as a percentage of original achievement appeared to follow somewhat the same general trend as that for Information, but it appeared for all groups except Group E to be higher (8.23, 11.95, 13.99, 11.88, 14.47, 23.23).

The form of the distribution of the Full Scale *IQ* scores did not change significantly between examinations. The correlations between examinations for Full Scale *IQ* (+.925), Vocabulary (+.922), and Information (+.911) did not lend support to the presence of a distorting process. The Vocabulary changes were consistent throughout the entire *IQ* range. The Information changes were orderly in relation to initial intellectual ability. A significant percentage of subjects showed no decrement in achievement on these scores. Forty-one per cent of the subjects had either a larger Information score on the second examination or no change. Twenty-two per cent showed increased or no change scores for Vocabulary on the second examination.

If malignant senility more adversely affected Information than Vocabulary, its effect was not evident in our study. A final bit of positive evidence for this conclusion concerned correlations between these two subtests and Full Scale *IQ*. As determined in our sample, the relationship between initial intellectual achievement and change in achievement on the Information subtest was small but might be significant. The correlation between change in Information score between examinations and the Full Scale *IQ* on the first test was +.172 ($p < .05$). It increased to +.294 ($p < .05$) for the Full Scale *IQ* on the second test. The correlation between all *IQ* measures and change in Vocabulary Score between examinations did not differ significantly from zero.

² We realize that it has not been established that any Wechsler-Bellevue subtest score has an absolute zero. Neither do we know whether the interval steps for any subtest are always of equal value except possibly for a potentially large random fluctuation from one interval to the next. Change scores on the Wechsler-Bellevue expressed as a proportion of a former achievement must be evaluated within these reservations.

Our sample was institutionalized people. There was a possibility that an environment with the attenuated or distorted social stimulation of an institution might seriously impair Vocabulary or Information achievement. To measure the Vocabulary and Information stimulation of the environment a survey of 10 months of reading practices of the members was made. The following information was uncovered. The average census of any one day was 1050 residents. The library available to these residents was open 6-1/2 days per week. A day was 12 hours. The library offered 15,000 titles of books in every category available in a general library. There were 34 daily newspapers, 26 weekly magazines, six weekly newspapers, and 137 monthly magazines. There were 500 active book borrowers who borrowed an average of 120 books per day. Forty magazines were given away daily to the residents as gifts. An additional 120 residents used the library daily for periodical reading. Six hundred and thirty-five daily newspapers were sold at the Center Canteen. A large, but unknown number of periodicals of all kinds was brought in daily by the residents from the local town, or was received in the mails. Decline in recognition Vocabulary or Information achievement attendant, upon possible disuse, resulting from institutional living did not seem probable. It could be that oral or recall vocabulary declined but this seemed unlikely and we know of no evidence to support the possibility.

The data from our sample offered further information on the relative effect of age on changes in achievement in different subtests. Howell (12) using the results of a stratified study measured the deteriorative effects of advancing age by comparing achievement on three Verbal subtests (Information, Vocabulary, and Comprehension) with achievement on three Performance subtests (Picture Arrangement, Block Design, and Digit Symbol). The rationale was that the verbal subtests were more resistant to decline with age.

In our sample the largest coefficients of correlation of raw score with age were obtained with initial age and scores on second test on Digit Symbol ($-.348 \ p < .05$), Picture Arrangement ($-.310 \ p < .05$), and Block Design ($-.266 \ p < .05$). The corresponding correlations for Comprehension ($-.205 \ p < .05$), Information ($-.121 \ p > .05$), and Vocabulary ($-.085 \ p > .05$) indicated that raw scores on the latter three tests were less related to age than the former three. This supported the concept that size of scores on these subtests was in part a function of age.

Correlations between chronological age at first testing and difference scores between examinations for each subtest were different from those just reported for raw score and age. The largest correlation between decrement and age

was for Information ($-.267\ p < .05$) whereas before the largest was with Digit Symbol ($-.348$). The Vocabulary and Comprehension correlations ($-.143\ p > .05$ and $-.185\ p < .05$) did not in the aggregate indicate that these tests were less susceptible to decrement than Block Design, Digit Symbol, and Picture Arrangement ($-.174\ p < .05$, $-.188\ p < .05$, and $-.060\ p > .05$ respectively). It will be recalled that correlations between change in score and interval between testing were all low. The highest was $-.232$ for Object Assembly. It is obvious therefore that the interval between tests did not significantly influence the correlations between chronological age and difference scores.

It is probable that advancing age had a selective effect on various subtests. But our data did not support the belief that Performance scores were the more adversely affected with advancing age. Performance subtests did show the largest mean differences in raw scores between examinations (Table 1), but the negative correlations between advancing age and difference scores were no greater for Performance subtests than for Verbal subtests. The mean correlations for age and change in score were $-.132$ for Verbal subtests and $-.133$ for Performance subtests.

It is, of course, well established that advancing age is associated with a mean decline in intellectual achievement in most people. This has long been suggested by many studies (2, 5, 10, 14, 16) and is corroborated by this one. Schaie (19) had suggested that different functions peak out at different age levels. An individual may be declining in one or more intellectual functions, but because another function (or functions) is still growing, global intelligence seems intact. The occurrence of a large percentage of improvement scores in our sample was consistent with this concept. For each subtest a varying percentage of up to 32 per cent had a higher raw score on the second examination of a subtest than on the first. While this was possibly due to errors of measurement, it was unlikely that they could all be ascribed to this cause. The mean Verbal and Performance scores were consistently smaller. Those who showed improvement on any subtest were not constant from one subtest to another. Even in the age ranges 56 to 65 there were individuals who were not declining in all functions, and some who were improving on some.

Our data supplied further information on the relative effect of advancing age on the relative decline in achievement of bright and dull people. Correlations between Full Scale *IQ*, Verbal *IQ*, and Performance *IQ* on the first and second examinations have already been cited to indicate that comparative intelligence status held up excellently. Correlations between scores on the

first examination and the second examination for any subtest were positive and high. They varied from $+.617$ for Picture Arrangement to $+.922$ for Vocabulary.

The data developed in this study has implications for the kind of samples that should be used in this type of research. The correlations between achievement on a subtest on the first examination and the change in score between examinations were all negative. A negative correlation implied that those who had the higher initial raw score on a subtest tended to have larger declines as measured by the difference scores between examinations. The range of these correlations was large. The smallest correlation was for Information ($-.034$ $p > .05$) and the largest was for Digit Symbol ($-.546$ $p < .05$), although for the latter test decline was not more prevalent (76 per cent of the sample) than for the former (75 per cent of the sample). For Information it has been noted that decline was relatively small in the upper three *IQ* groups as compared with the three lowest *IQ* groups. It was the only subtest in which the mean difference scores for the lowest *IQ* groups were greater than the difference scores for the highest *IQ* groups (Table 3). It was apparent then, that if a sample were heavily loaded with high *IQ* people, we might find relatively fewer persons showing decline on the various subtests with advancing age. If a sample were heavily loaded with lower *IQ* people the decline in Information score would be considerably greater. An exception to this observation was Digit Symbol, where there was a significant decline in all *IQ* groups except one, being at the five per cent level in all groups except the lowest *IQ* (Group F). A stratified sample that was not adequately balanced for the range of *IQ* groups would not produce a distortion of the effect of advancing age on achievement for this subtest.

One of the important aspects of this study was a methodological one. It provided data by which a direct comparison of a stratified sample study with a longitudinal study could be made. Stratified sample studies of achievement on the Wechsler-Bellevue Form I at these age groups using scaled scores have reported decreasing achievement in most of the subtests (3, 4, 10, 12). The achievement on the Wechsler-Bellevue Form I of a stratified sample in the same age ranges drawn from the same institution was available for comparison (2). The results of this stratified sample were reported in raw score form and could, therefore, be directly compared to the changes on this sample. Table 4 compares the changes in absolute raw scores in the two studies. The first column gives the mean change in raw scores between age groups 55-59 and 65-69 in the 1953 study. Only four of the 11 subtests showed significant decline between these two stratified samples 10

years different in chronological age and all four are among the traditional "Don't Hold" tests. The second column gives the changes in the mean score from the first examination to the second for each subtest of the longitudinal sample. All the subtests showed a significant mean decline in achievement when retested an average of 8.65 years later. It should be noted that the largest declines were not restricted to the "Don't Hold" tests.

There can be several objections raised to the above comparison. One is that in the stratified sample the comparisons were made at a 10 year interval while in the longitudinal study the mean interval was 8.65 years. In the stratified samples the mean age of the base groups (55-59) was greater than the mean age of the longitudinal sample study at the first examination. Similarly the mean age of the stratified sample study in the 65-69 year group was greater than the age of the longitudinal study sample at the time of the second examination. All of these factors should increase differences in raw scores between successive stratified age groups. Despite these possible biases that might magnify changes between the stratified age samples, the decline in achievement on the longitudinal study apparently was greater than the difference in score between the two stratified age groups. While three subtests of the stratified study showed absolute increases in achieved score from age 55-59 to 65-69, no subtest on the longitudinal study showed a mean increase from the first examination to the second. The only difference between differences which was statistically significant, however, was that for the Vocabulary subtest.

Column 3 gives the differences between the mean raw scores for the stratified sample ages 55-59, and the first examination of the longitudinal study. The mean scores on the latter were in all cases numerically larger but the differences were statistically significant in only 3 cases. It should be noted that the mean IQ of the 55-59 group was 99.95 while the mean of the longitudinal group was 100.72. This very small difference of itself would not be expected to result in all subtest differences having the same sign.

Comparing the mean scores of the next higher stratified age sample (60-64) with the mean scores on the first examination of the longitudinal study (Column 4) we found that for every subtest the mean raw scores for the latter group were increasingly greater, only one being nonsignificant. As age differences increased the difference scores would be expected to increase.

The stratified sample for ages 60-64 showed six subtest means that were numerically larger than the corresponding means on the retest of the longitudinal series (Column 5), none of these being significant. Five were numeri-

TABLE 4
DIFFERENCES IN MEAN RAW SCORE BETWEEN WECHSLER-BELLEVUE EXAMINATIONS COMPARING STRATIFIED SAMPLES AND LONGITUDINAL MEASURES^a

	Ages 55-59 <i>vs</i> Ages 65-69	Age 56.32 <i>vs</i> Age 64.97	Ages 55-59 <i>vs</i> Age 56.32	Ages 60-64 <i>vs</i> Age 56.32	Ages 60-64 <i>vs</i> Age 64.97	Ages 65-69 <i>vs</i> Age 64.97
Comprehension	+ .05	— .74*	+ .36	+ 1.24*	+ .50	— .43
Digit Span	— .73*	— .58*	+ .10	+ .50	— .08	+ .25
Arithmetic	— .46	— .70*	+ .39	+ .43*	— .27	+ .15
Similarities	— .37	— 1.50*	+ .88*	+ 2.04*	+ .54	— .25
Picture Arrangement	— .98*	— .92*	+ .70*	+ 1.06*	+ .14	+ .76
Picture Completion	— .52	— .48*	+ .32	+ .79*	+ .31	+ .36
Block Design	— 2.39*	— 3.25*	+ .50	+ 1.73*	— 1.52*	— .36
Object Assembly	— .97	— 2.02*	+ .50	+ 1.24*	— .78	— .55
Digit Symbol	— 3.13*	— 4.29*	+ 1.51	+ 2.68*	— 1.61	+ .35
Information	+ .12	— .99*	+ 1.11*	+ 1.43*	+ .44	.0
Vocabulary	+ .23	— 2.81*	+ .26	+ 1.76*	— 1.05	— 2.78*

* $p < .05$.

^a Ages 55-59 Stratified Study $N = 404$.

Ages 65-69 Stratified Study $N = 84$.

Age 56.32 Longitudinal Study $N = 184$.

Age 64.97 Longitudinal Study $N = 184$.

Ages 60-64 Stratified Study $N = 278$.

cally smaller, only one difference being significant. When comparing the next older stratified age group (65-69) with the retest means (Column 6) we should expect that the minus differences in Column 5 either have become smaller or have changed into plus differences, or that the plus differences have increased in magnitude. This occurred for seven of the subtests. It did not occur for Comprehension, Similarities, Information, and Vocabulary.

The results of a longitudinal study have definite advantages over those of the stratified method. They are freer from extraneous variables that may arise in samples drawn from populations by methods that lack adequate randomization for these variables. They possess the greater precision that results from the use of repeated measurements. Because of these factors we consider the results of our longitudinal study to provide a standard against which to compare the results of the stratified study.

A comparison of the results of the longitudinal study with those found in the stratified samples revealed significant disparities. The longitudinal study disclosed significant mean decrement in achievement in all subtests after a mean interval of 8.65 years. For the two stratified groups differing by an average of 10 years, only four subtests showed significant mean decrement in achievement. These were four of the conventional "Don't Hold" subtests proposed by Wechsler (22).

We feel that the results show that the relative lack of precision of the stratified samples cannot be expected to give consistent results. For instance a comparison involving a six year difference (Column 4 Table 4) yielded results comparable to the longitudinal study, while the comparison involving a 10 year difference (Column 1 Table 4) failed to do so. When short time intervals are involved significance of differences might not be expected but note that for a one year difference all signs of differences were consistent while for each of two 2.5 year comparisons they were not.

There are numerous cultural and psychological vectors that affect performance on a test such as the Wechsler-Bellevue. Factors such as these may have in part produced the differences in results of the two kinds of studies. Until these can be adequately controlled for randomness in stratified samples, the measure of change with age using stratified samples cannot always be expected to be similar to that found using the serial method.

It was interesting to note that the extrapolation system utilized by Wechsler (22) to convert Full Scale, Verbal, and Performance *Scale Scores* to *IQs* created in our sample paradoxical results. For the entire sample and for each subgroup, the three composite *scaled scores* showed differences between examinations that were significant. Yet even though for the entire

sample the three composite *IQ Scores* were significant, of the eight subgroups only for Group AB, and no other, was the change of Performance *IQ* significant. The Full Scale *IQ* and Verbal *IQ* differences between examinations did not reach an acceptable statistical level of significance in Groups E, F, and EF. This raised the question whether in using the Wechsler-Bellevue in experimentally evaluating changes with advancing age, there is some distortion in converting raw scores into scaled scores and converting the latter into *IQ* scores. The latter conversion may give a biased estimate of *IQs*. It will be necessary to guard against such a possibility using WAIS or any test using conversions such as these.

E. SUMMARY AND CONCLUSIONS

The longitudinal changes in achievement between mean ages 56.32 and 64.97 in 184 institutionalized males, on the Wechsler-Bellevue, were investigated in this study. The *IQs* of the group covered the range of the general population. A comparison was made with the results reported in a stratified sample of aged males of the same social background. The following conclusions seemed warranted:

1. Between ages 56 and 65 in all functions measured there was a mean decrement in ability. There was no evidence that this decrement was due to accelerated senility.
2. There was a decline in Verbal achievement as well as in Performance achievement. The declines in verbal subtests were approximately equivalent to those in the performance subtests.
3. For the total sample, Vocabulary and Information declined. The decline in Vocabulary was consistent for all *IQ* groups. The Information decline was greatest for low *IQ* groups. There were indications on other verbal subtests that achievement was related to decrement resulting from aging.
4. Comparing performance subtests with verbal subtests to measure changes due to aging is of dubious validity.
5. Decrement in achievement is not omnipresent in the age period 56 to 65. While for most people most functions may be declining, for some people some functions may be improving.
6. The intellectually most able at the beginning of the study remained the most able at the end of the study. The highest achievers on the first examination generally were the highest achievers on the second examination.
7. Results in studies such as this probably will be dependent in part on the range of *IQs* included in the sample.

8. Decrement in achievement with advancing age, measured by the use of a stratified sample, differed from that shown by serial retesting after a lapse of years.

9. The results reported in this study support the proposition that relationships between changes and aging should be developed primarily through the use of longitudinal studies.

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A FACTOR ANALYSIS OF PSYCHOLOGICAL DEFICIT*¹

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A. INTRODUCTION

Psychological deficit is a loosely employed term the content of which includes almost the whole of behavior and experience. Its manifestation may range from the subtle and overtly compensated to the grossly disruptive which is obvious to even the unsophisticated observer. Its presence is at least implied whenever the organism fails to perform at a level heretofore demonstrated or equal to that of criterion groups said to be without the deficit as judged against some independent variable. The independent variable may represent, for example, transitory conditions created by stress, fatigue, drugs, etc., or relatively persistent conditions produced by structural and functional alterations within the central nervous system, or by progressive changes associated with advancing age. Reitan (26) has reviewed the problems and complexities of the relationships between dependent and independent variables in the study of psychological deficit.

Over the years, and in one manner or other, most of the techniques of both clinical and laboratory psychology have been employed to assess deficit. Some of the measures were originally developed to assess particular types of deficit but subsequent research has suggested that the technique might also be sensitive to other kinds of deficit. For example, on the basis of developmental studies and her initial group comparisons, Bender (3, 4) offered her visual-motor gestalt test as a useful technique for the detection of deficit attributable to changes in the central nervous system. Subsequently, Hutt (20) using the same test materials but different criteria for the bases of his interpretation, demonstrated that the test could be used to detect psychological deficit which had its origin in emotional difficulties. Most of the laboratory or "brass instrument" methods for assessing deficit, however, had their origin in general experimental psychology. The subjective fusion of intermitting light (CFF), for example, was initially a phenomena requiring explanation in

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visual theory. In recent years its usefulness as a measure of individual differences and deficit has also been explored. The psychological literature is replete with other examples of the proliferation of techniques proposed and investigated for demonstrating differences between "deficit" and "non-deficit" groups.

In fact, there has been such a number and variety of measures proposed that there is a real need to conduct a multivariate investigation to elucidate the interrelationships and degree of overlap among these several measures of psychological deficit.

In a like sense, the bases for the psychological deficit may be many. In clinical practice, the psychologist is frequently asked to identify or differentiate the bases of the manifest deficit. The differentiation, however, is usually a rather global or generic type, e.g., organic vs. functional, psychotic vs. neurotic, etc. This approach has been rather severely criticized (26) and, in recent years, some progress has been made in the specification of the bases for the deficit in psychological functioning. Some of the findings reported in the recent literature would suggest, however, that there are some psychological techniques which will identify a generalized type of deficit while others may reveal a specific or unique basis for the deficit. It is for these reasons that there is a compelling need to conduct a taxonomic study among these several tests and techniques which appear to "measure" psychological variables which will better describe or assess these differences in responses.

With these objectives in mind, a selected group of psychological techniques frequently utilized to measure behavioral deficit, was assembled as a battery and administered to a heterogeneous group of subjects. This study is concerned both with measures and with kinds of deficit. Thus, the sample was chosen to include more or less independent representations of populations assumed to have little or no deficit and populations which have deficits primarily associated with some of the commonly used generic categories, viz., age, brain damage, psychoses, and psychoneuroses.

The scores resulting from this series of measures were intercorrelated, factor analyzed, and the factors interpreted. The data were also analyzed to ascertain if the several deficit groups performed differentially on any of the individual tests in the battery. It was hoped that such a program of analysis might produce information regarding certain aspects of behavioral deficit and permit certain conclusions regarding families or clusters of psychological processes that are related to behavioral deficit. While psychology, and especially the clinical branch of the discipline, has been justifiably concerned with the etiology of deficit for diagnostic reasons, a new and

empirically defined classification of deficit performances may shed new light on the factors common to deficits with different etiologies. Such results may provide new hypotheses useful for behavioral modification. The present study is confined to the first or analytic stage of this program of inquiry.

B. METHOD

1. *Subjects*

The major concern of this study does not involve subgroups within the population, but certain distinct subgroups were used for two reasons: (a) to maximize the heterogeneity of the total sample with respect to variations in psychological deficit, and (b) to permit an analysis of the distinctiveness of the resulting factors for certain commonly classified deficit groups.

Eighty-eight adult males were chosen from the patient-member population of the Veterans Administration Center at Kecoughtan, Virginia. These subjects were obtained from the following classifications: (a) sixteen with histories of cerebrovascular accidents with residual hemiparesis, resident in the domiciliary, and expected only to perform "activities of daily living"; hereafter identified as "organics" (age range: 46-67 years). (b) sixteen domiciliary residents formerly hospitalized for chronic schizophrenic reactions, with the conditions stabilized at a level permitting adequate functioning in a sheltered nonhospital institutional environment; hereafter identified as "psychotics" (age range: 33-73 years). (c) fifteen domiciliary members with diagnoses of chronic bronchial asthma or rheumatoid arthritis, assumed to involve psychosomatic etiology; hereafter identified as "psychosomatics" (age range: 47-71 years). (d) forty-one male patients convalescing from acute illnesses and awaiting discharge from the hospital within a few days, free of histories of psychiatric or central nervous system disorders. Twelve Ss were under 35 years of age and are hereafter identified as "young normals" (age range: 26-30 years). Seventeen Ss were between 35 and 55 years of age, hereafter identified as "middle age" (age range: 36-55). Twelve Ss were over 55 years and are hereafter identified as "old normals" (age range: 55-69). In some concepts, this latter group is used as a sample of deficits due to aging.

2. *Procedures*

The laboratory and clinical techniques used in this study were chosen to represent a variety of psychological functions. Research on most of these techniques has demonstrated their ability to detect individual and group differences. For the most part, studies have been reported which suggest inter-relationships with one or more of the other techniques used. Table 1

lists the measures employed and the references for each technique which are most pertinent to this study.

TABLE 1
NUMBER, NAMES, AND MAJOR SOURCE REFERENCE FOR FORTY-TWO VARIABLES

1. Chronological Age	
2. Ohio Literacy Test	
3. Gottschaldt Embedded Figures (Witkin, 1950; Thurstone, 1944)	
4. Dogmatism Scale (Rokeach, 1956)	
5. Conventional Mores	
6. Hostility Scale	} Famous Sayings Test (Bass, 1958)
7. Fear of Failure Scale	
8. Social Acquiescence	
9. Wechsler-Bellevue Vocabulary List, Form I (Payne, 1961; Wechsler, 1944)	
10. L Scale	} MMPI (Dahlstrom & Welsh, 1960; Hathaway & McKinley, 1951)
11. F Scale	
12. K Scale	
13. Hypochondriasis Scale	
14. Depression Scale	
15. Hysteria Scale	
16. Psychopathic Deviate Scale	
17. Masculinity-Femininity Scale	
18. Paranoia Scale	
19. Psychasthenia Scale	
20. Schizophrenia Scale	
21. Hypomania Scale	
22. Social Introversion Scale (Drake, 1946)	
23. Exercise 1—Maze	} Revised Beta Examination (Kellogg, Morton, Lindner, & Gurvitz, 1957)
24. Exercise 2—Code Substitution	
25. Exercise 3—Error Detection	
26. Exercise 4—Spatial Arrangements	
27. Exercise 5—Picture Completion	
28. Exercise 6—Similarities	
29. Total IQ	
30. Mental Health (Brenkelmann, 1961)	} House-Tree-Person Drawings
31. Behavioral Efficiency	
32. Mental Health	} Bender Visual-Motor Gestalt Test (Brenkelmann, 1961; Bender, 1938, 1946; Hutt, 1945)
33. Behavioral Efficiency	
34. Apparent Movement Perception (Brenner, 1953, 1956; Meyer, 1961; Coppinger & Saucer, 1960)	
35. Critical Flicker Frequency (Granger, 1961)	
36. Shortest Noticeable Dark Time (Coppinger & Saucer, 1959; Colgan, 1954; Farmer, 1950)	
37. Tapping (King, 1954)	} MMPI
38. Work Attitude Scale (Tydaska & Mengel, 1953)	
39. Ego Strength Scale (Barron, 1953)	
40. Dependency Scale (Navran, 1954)	
41. Dissimulation Scale (Gough, 1954)	
42. Morale Loss Scale (Carter, 1960)	

The Ohio Literacy Test was included in order to determine the way in which reading comprehension might influence the scores on some of the other tests. The Famous Sayings Test was used as a measure of response set in accord with the notion that response sets may be as characteristic of a group as is their performance on other types of measures. Some commonly used clinical techniques were excluded because of time limitations and the difficulty of fitting their scoring schemas into the format of this study.

The Ohio Literacy Test, Gottschaldt Embedded Figures, House-Tree-Person, Famous Sayings Test, Revised Beta Examination, Bender Gestalt and the D Scale were administered in one session. The order of presentation was randomized and was administered in small groups which were heterogeneous in composition. Standard directions, including time limits where applicable, were used. The MMPI was given in a separate session. An examiner read the items if the subject's reading comprehension was such that scores on the MMPI might be invalidated or if his speed of response might unduly prolong the session. The Wechsler Vocabulary, Critical Flicker Fusion, Shortest Noticeable Dark Time Thresholds, Apparent Movement, and Tapping rates were obtained during individually scheduled sessions. The sessions were scheduled over a minimum of two days. Testing time ranged from six to 10 hours for each subject.

With the exception of the MMPI scores (where the established *T*-scale scores were used) the scores from the pooled sample of 88 cases were used to develop *T*-score scales (i.e., normalized distributions with *M* of 50 and *S.D.* of 10). The Bender Gestalt and the House-Tree-Person were *Q*-sorted by three judges along two subjectively defined dimensions of mental health and behavioral efficiency. These two dimensions were considered necessary for these measures since it was reasoned that some groups, e.g., paranoid schizophrenics, might show very efficient performance though they would be rated quite differently in terms of mental health. The between-judge reliability of the *Q*-sorts was of such a magnitude (ranging from *r*.85 to *r*.88) that the sorts from a single judge were used as the basis for the *T*-score scales.

C. ANALYSIS OF DATA

Means, standard deviations, and intercorrelations were computed for the 42 measures taken on the 88 subjects. The correlation matrix was factor analyzed by the centroid method (29) and nine factors were extracted. These factors were rotated orthogonally to a simple structure by the Varimax method. The resulting factors were plotted in pairs, and inspection revealed that a simpler structure could be achieved through additional oblique rotations.

These were performed and a final configuration was arrived at in the oblique rotated matrix.²

Table 2 gives the means and standard deviations on each measure for the six groups and the pooled data.

Table 3 presents the final rotated (oblique) factor matrix.^{3, 4}

As an adjunct to the factorial analysis, comparisons were made of the performance level of the normal young group with each of the four deficit groups on all the tests. In order to compare these differences, point biserial correlations were computed in which the two-point "dummy" variable consisted of young normals versus each of the deficit groups separately, namely, old, organic, psychotic, and psychoneurotic. Each of the 42 variables thus was correlated with each of the four dummy variables (group contrasts) in which "young normals" were considered the positive pole.

It was thought that this additional form of analysis would provide more definitive information about the nature of each factor and about the composition and utility of each of the measures. The point biserial correlation coefficients that were statistically significant at the .05 level are presented later in the discussion of the interpretation of the factors.

Each of the nine factors is interpreted in terms of the measures which have high factor loadings on it. The interpretations are added and extended by the consideration also of the measures which have vanishing loadings on a particular factor, and also by the significant point biserial correlations with the dimensions identified by each deficit group in the sample as contrasted with the "young normal" group.

Factor A seems to be an intellectual factor. It is dominated by the Beta IQ. The part-whole relationship between this representation of the total Beta score and the Beta subtests may distort the factor to some degree. The Beta IQ is an expression of the total score and must, perforce, have

² As a result of this experience the authors advise against the acceptance of an arbitrary varimax solution without plotting the results to see the degree to which a simpler structure may be achieved in a factorial solution.

³ Factorial studies ordinarily present the correlation matrix (R), the centroid or unrotated factor matrix (F), the transformation matrix (Lamda), the final rotated matrix (V), and either the C-matrix or the R_{pq} -matrix in the case of the oblique solutions. In the present study only the final oblique factor matrix is presented as being of primary interest.

⁴ Supplementary tables of intercorrelations, factor analysis, varimax rotation, and the transformation matrix have been deposited as Document number 7539 with the ADI Auxiliary Publications Project, Photoduplication Service, Library of Congress, Washington 25, D.C. A copy may be secured by citing the Document number and by remitting \$1.25 for photoprints, or \$1.25 for 35 mm. microfilm. Advance payment is required. Make checks or money orders payable to Chief, Photoduplication Service, Library of Congress.

TABLE 2
MEANS AND STANDARD DEVIATIONS FOR FORTY-TWO VARIABLES

Variable	Total		Young		Middle Age		Old Age		Hemiplegics		Psychotics		Psycho-somatics	
	M	σ	M	σ	M	σ	M	σ	M	σ	M	σ	M	σ
1	51.5	13.4	30.3	1.9	43.2	5.9	63.2	4.9	58.8	7.3	49.9	12.9	62.3	6.1
2	49.0	9.4	48.9	11.0	48.2	7.8	47.7	8.3	48.7	8.1	53.0	10.8	47.1	8.9
3	50.3	9.5	57.5	10.1	51.2	9.2	45.7	6.6	48.6	9.6	53.4	8.1	45.5	7.2
4	49.7	9.6	41.8	9.7	46.6	7.3	55.3	10.0	51.1	7.9	49.5	7.5	53.4	10.0
5	48.9	8.3	47.2	7.0	47.7	7.2	50.5	8.3	49.8	9.1	46.0	9.3	52.7	6.2
6	49.9	9.7	47.7	6.4	49.9	5.8	48.5	11.8	50.4	13.6	50.1	9.3	51.9	8.3
7	49.3	9.8	44.7	6.1	48.0	8.8	48.9	10.4	50.8	12.4	47.2	9.2	55.2	6.5
8	50.8	9.7	45.4	6.5	51.2	8.5	50.4	8.8	53.4	11.8	49.8	10.6	53.1	8.2
9	49.7	9.5	44.8	6.8	51.1	7.4	51.5	11.0	48.2	11.4	53.6	9.8	48.1	7.1
10	56.1	7.6	55.2	5.5	56.0	7.1	52.3	3.9	58.8	8.6	59.5	8.9	53.2	6.2
11	61.2	9.4	58.2	7.1	57.9	7.6	67.2	11.8	58.8	6.8	62.7	9.4	63.6	10.0
12	51.6	10.0	54.0	12.3	53.0	9.0	46.7	6.4	54.2	9.4	53.1	9.8	47.5	9.5
13	67.9	15.5	66.3	20.9	68.6	13.1	70.2	14.2	67.7	11.1	64.0	16.9	71.2	15.2
14	69.0	12.9	70.7	8.9	64.7	10.5	69.8	13.3	68.6	13.8	72.1	14.8	69.0	13.1
15	60.4	12.0	59.0	9.4	59.2	11.3	63.0	14.7	62.4	9.3	58.6	13.6	60.7	12.3
16	61.6	12.6	61.9	9.0	59.4	10.7	62.9	12.9	62.7	7.0	58.2	14.3	65.0	17.2
17	53.8	8.1	56.0	7.8	52.2	2.8	55.8	7.3	50.2	6.1	56.6	6.5	53.2	10.5
18	56.6	12.1	55.5	10.3	55.9	10.8	62.5	12.4	53.7	11.1	54.9	12.5	58.3	13.1
19	61.4	14.1	59.6	11.1	58.8	12.2	73.8	14.5	58.6	14.3	56.8	8.5	63.9	16.2
20	62.6	14.2	56.1	7.2	60.6	13.3	74.0	18.1	62.1	10.8	62.7	10.7	61.6	16.7
21	59.0	12.3	55.7	13.3	58.3	11.9	64.9	11.1	60.5	11.0	56.0	11.0	59.4	13.6
22	54.1	9.9	51.3	7.7	49.5	6.7	55.9	14.4	52.3	10.1	57.8	8.4	57.7	8.2
23	49.6	9.5	59.6	7.7	52.6	8.2	45.3	6.1	45.4	8.8	51.2	7.5	44.7	9.0
24	49.1	9.7	53.7	12.3	53.1	7.4	44.2	6.6	44.3	8.6	52.1	8.9	46.4	8.8
25	50.9	10.4	62.9	10.8	53.3	7.6	45.7	9.1	47.1	6.9	52.3	7.9	45.0	9.4
26	49.6	10.7	51.2	15.0	50.6	8.6	45.7	9.6	48.1	10.1	56.1	9.5	44.9	7.0
27	49.5	10.2	54.6	13.3	53.8	8.6	46.5	8.8	45.3	7.4	48.6	11.1	48.6	8.1
28	49.6	10.0	52.3	12.1	54.1	7.7	43.2	6.7	46.5	9.3	52.7	9.0	47.2	9.8
29	50.1	9.8	52.0	9.0	52.5	9.6	47.4	8.7	48.9	8.8	50.2	11.5	49.1	9.6
30	50.4	13.3	53.3	11.0	55.3	13.8	45.0	11.9	52.5	16.4	52.5	10.3	42.7	9.3
31	50.2	13.4	55.8	12.5	52.9	10.1	44.2	9.5	48.7	15.4	56.9	13.6	42.0	10.4
32	50.1	12.8	55.0	12.6	52.9	10.7	45.0	11.9	46.9	11.6	53.1	15.3	47.3	11.2

TABLE 2 (continued)

Variable	Total		Young		Middle Age		Old Age		Hemiplegics		Psychotics		Psycho-somatics	
	M	σ	M	σ	M	σ	M	σ	M	σ	M	σ	M	σ
33	50.1	13.0	55.8	11.9	52.3	13.5	44.2	9.5	52.5	12.0	51.2	12.7	44.0	13.1
34	49.9	9.4	53.3	9.8	46.5	7.6	51.6	12.2	48.7	8.4	51.2	8.3	49.8	8.8
35	50.1	9.6	45.2	6.2	46.0	7.6	55.9	7.1	52.7	9.3	50.4	11.9	50.8	9.1
36	49.3	9.7	41.6	5.6	47.6	8.2	49.9	11.5	48.8	10.0	53.2	8.8	53.1	8.5
37	49.6	11.0	53.2	11.4	54.5	6.0	48.5	9.9	50.4	7.5	49.9	8.8	40.7	15.2
38	23.4	20.3	27.6	22.9	16.5	13.7	18.6	4.8	23.9	23.3	33.2	27.2	20.9	14.0
39	35.9	7.1	38.6	6.7	35.7	5.5	32.1	8.0	37.8	5.9	37.5	8.0	33.3	6.1
40	29.8	15.3	26.6	7.8	33.1	16.2	29.5	9.7	22.6	6.2	29.9	23.7	36.4	13.8
41	41.2	28.3	32.6	31.1	47.0	30.2	28.2	21.8	41.9	24.3	45.1	25.6	47.3	30.0
42	35.8	26.4	29.9	24.7	36.5	26.0	36.4	28.3	41.7	28.3	34.9	26.5	34.2	22.8

TABLE 3
OBLIQUE ROTATIONS

Variable	A	B	C	D	E	F	G	H	I	h^2
1. Age	-.060	.023	.115	.055	.118	.477	-.161	-.180	-.121	.335
2. Ohio	.511	-.074	.113	.260	.209	.258	-.208	.091	-.205	.551
3. Gott	.330	-.090	-.223	.029	.242	.038	.276	.161	-.185	.364
4. "D"	-.280	.178	.235	-.078	-.089	.063	.088	.172	-.137	.239
5. CM	.303	-.085	.461	-.092	.080	.202	-.150	-.231	.230	.496
6. HO	.070	-.013	.581	-.165	-.076	-.081	.108	.014	-.065	.398
7. FF	-.009	-.097	.662	-.040	-.084	.074	-.107	-.015	.049	.476
8. SA	-.053	-.023	.736	-.002	-.034	.088	.032	.062	.172	.588
9. Voc	.183	.091	.271	.134	.227	.044	.168	.104	-.234	.280
10. L	-.162	.054	.001	.694	-.038	.023	.122	-.072	-.092	.541
11. F	-.082	.435	-.078	-.402	.152	.038	.218	-.008	-.089	.444
12. K	.052	.091	-.038	.639	.092	.048	.095	-.074	.158	.471
13. Hs	-.091	.223	.099	-.058	-.109	-.108	.040	-.507	.140	.373
14. D	.065	.509	.406	.031	.014	-.108	-.012	-.272	-.040	.354
15. Hy	-.045	.266	.014	.083	-.085	-.114	-.012	-.646	.097	.527
16. Pd	.118	.576	.161	.135	.098	.045	.150	-.073	.257	.495
17. MF	.165	.437	.076	.172	.106	-.046	.050	.102	.092	.264
18. Pa	.019	.724	-.067	-.180	.211	.030	-.032	.134	.350	.748
19. Pt	.029	.714	.057	-.042	.042	-.053	-.066	-.092	.395	.689
20. Sc	-.110	.569	-.051	-.109	.044	.069	.101	.021	.316	.467
21. Ma	-.008	.233	-.049	-.301	-.146	.090	.001	.040	.437	.369
22. Si	.039	.481	.093	-.026	.046	-.023	-.090	-.045	-.109	.267
23. T1 Beta	.327	.048	-.016	-.002	.104	-.290	.029	.111	.068	.222
24. T2 Beta	.736	.010	.014	.037	-.028	.060	.109	.023	.029	.561
25. T3 Beta	.272	.036	.071	-.022	.216	-.358	.192	.097	-.076	.308
26. T4 Beta	.631	-.047	-.056	-.007	-.066	.177	.113	.064	-.076	.462
27. T5 Beta	.689	-.067	-.130	-.338	-.131	-.103	-.045	-.117	.036	.655
28. T6 Beta	.747	.066	.035	.028	.039	.044	-.037	-.019	-.065	.574
29. Total	.768	.065	.255	-.016	.272	.093	.036	-.110	-.041	.757
30. HTPM	.214	.010	.108	-.067	.350	.044	.511	-.172	.098	.487
31. HTPB	.258	.023	.081	-.013	.203	.010	.645	.083	-.044	.540
32. BM	.360	.096	-.024	.048	.618	.233	.042	.051	.009	.582
33. BB	.188	.022	.104	-.010	.622	.091	.198	.099	.062	.495
34. AM	-.087	-.023	-.181	.246	-.132	.030	-.179	.385	-.081	.290

TABLE 3 (continued)

Variable	A	B	C	D	E	F	G	H	I	h^2
35. CFF	-.084	-.020	-.075	.107	-.006	.593	.147	.033	.027	.400
36. SND	-.013	.065	.159	.327	-.026	.549	-.079	.177	.041	.478
37. Tap	.088	.012	-.024	.124	-.182	-.277	.232	-.008	.061	.191
38. Wa	.006	-.114	-.108	.312	.087	.137	.064	-.131	-.243	.229
39. Ego	.071	-.097	.114	.549	-.128	-.149	.084	.290	-.095	.477
40. Dep	.058	.015	-.105	-.079	.013	.011	-.098	-.019	-.261	.099
41. Diss	-.090	-.060	.128	-.079	.092	-.001	-.159	-.054	.208	.114
42. ML	.106	.048	.104	.094	-.368	-.117	-.030	.009	.130	.200

TABLE 4
FACTOR A

No.	Variable	Loading	Old Normals	Significant r_{pt}		
				Psycho- somatics	Organics	Psychotics
29	Total Beta	.768	—	—	—	—
24	Beta, Test 2	.751	.488	.377	.480	—
28	Beta, Test 6	.747	.454	.257	.289	—
27	Beta, Test 5	.689	.394	.291	.447	.291
26	Beta, Test 4	.631	—	.290	—	—
2	Ohio Literacy	.511	—	—	—	—
32	Bender, Mental Health	.360	.389	.298	.313	—
3	Embedded Figures	.330	.460	.633	.465	—
23	Beta, Test 1	.327	.750	.785	.740	.434
5	FS, Conventional Mores	.303	—	.330	—	—

a correlation with each of its parts despite the fact that it has been expressed in a different form. In addition, the Beta *IQs* were corrected for age; age may not load on this factor because of this. This may weaken the interpretation which we wish to make when we consider the interpretation of Factor F (q.v.).

Despite the intellectual nature of this factor and the part-whole relationships which may dominate it, three of the subtests have significant (more than 10 per cent) portions of their variances contributing to other factors (Beta subtests 1, 3, and 5). There are additional difficulties. The Wechsler Vocabulary failed to load significantly on this factor. Moreover, the Bender performance, when Q-sorted on a "mental health" continuum, loaded significantly while it failed to do so when the Q-sort was based on a "behavioral efficiency" continuum. One would have expected the converse to have occurred as it is reasonable to assume that intelligence is a component of "behavioral efficiency." The final problem in the interpretation lies in inclusion of the Conventional Mores Scale of the Famous Sayings Test.

The very high loadings of Tests 2 and 6 of the Beta may give a clue to the kind of intelligence that is present in this factor. Both of these subtests are relatively well defined tasks. Test 2 calls for code substitution; Test 6 is one of clerical comparison. Subtests involving a more critical approach to task solution may account for the positive loading of the Conventional Mores Scale and the absence of the "behavioral efficiency" Bender drawings. Drawings with a number of erasures would be penalized, but in

fact, reflect a more critical appraisal of one's reproductions of the drawings. For the same reason, Test 3 of the Beta which requires S to "Mark the thing that is wrong" demands an evaluation of relationships and fails to load on this factor while the Gottschaldt Embedded Figures and Test 4 (spatial relationships) of the Beta have only moderate loadings. The Wechsler Vocabulary spreads its variance over many factors and does not load on Factor A. It may be that this ability to recall definitions of words is least sensitive to pathology. However, it also demands a modicum of critical ability. That is, conventionalized, fairly uncritical definitions which meet the minimum directions for the task usually receive a minimum score of one.

This factor cannot be identified with any particular etiological classifications of deficit, though it should be remembered that the total Beta scores, which dominate the factor, were corrected for age. In view of these problems in interpretation, this factor is tentatively labelled, "Direction Following Intelligence."

TABLE 5
FACTOR B

No.	Variable	Loading	Old Normals	Significant r_{pt}		
				Psycho- somatics	Organics	Psychotics
19	MMPI, Psycho- asthenia	.714	.505	—	—	—
18	MMPI, Paranoia	.724	.290	—	—	—
16	MMPI, Psycho- pathic Deviate	.576	—	—	—	—
20	MMPI, Schizo- phrenic	.569	.633	—	—	—
14	MMPI, Depres- sion	.509	—	—	—	—
22	MMPI, Social Isolation	.481	—	.322	—	.323
17	MMPI, M-F	.437	—	—	.354	—
11	MMPI, F (fake- bad)	.435	.472	.283	—	—

Many of the items making up the MMPI Scales which load on this factor emphasize a discomfort with one's self and with others. Although this factor bears a striking resemblance to the "psychotic" factor extracted by Wheeler, Little and Lehner (33), two facts should be noted about the present findings: (a) The supposedly "young normals" in the present study deviate markedly from the standardization sample. Their mean score on the Depression Scale is two standard deviations above the mean of the standardization group. Their mean score on the psychoasthenia scale is

one standard deviation above the standardization group's mean. While there are many possible explanations for these findings, it should be borne in mind that the "normal" sample was convalescing from acute illnesses which had required hospitalization. Some unpublished work by Gottlieb suggests that the reaction to acute illness and hospitalization is reflected in gross disturbances in the MMPI profile. (b) High scores on the scales which load on this factor are not systematically associated with any of the etiological classifications of deficit employed in this study.

It may be that the pattern demonstrated by the "young normal" group is a normal reaction to illness among young males. If this assumption be tenable, it is possible to look upon the differences between the two groups, "young normals" and "old normals," as partially reflecting the differential impact of illness on younger and older individuals. The other deficit groups, by contrast, have been ill for longer periods of time, have made adjustments to supportive, institutional environments and have, perhaps, over the years brought to bear those defenses which may have characterized their adjustment even to institutionalization.

If this factor reflects generalized discomfort, then another difficulty in interpretation lies not with the measures which load on the factor but rather with the absence of those one would legitimately expect to load positively. The H-T-P and Bender drawings are missing. While the F scale from the MMPI is present, Scales K and L do not have the negative loadings one might expect.

These considerations place many restrictions on the interpretation of this factor. Until further study can clarify the nature of this factor, it appears that "Verbalized, Undefended Discomfort" is a suitable tentative label.

Factor C is composed of the four measures of the Famous Sayings Test, and is dominated by the Social Acquiescence Scale which was a second order

TABLE 6
FACTOR C

No.	Variable	Loading	Old Normals	Significant r_{pt}		
				Psycho- somatics	Organics	Psychotics
8	FS, Social Acquiescence	.736	—	.391	.411	—
7	FS, Fear of Failure	.662	—	.531	.311	—
6	FS, Hostility	.581	—	—	—	—
5	FS, Conventional Mores	.461	—	.331	—	—

factor derived from the original factor analysis (2). Thus, as in Factor A, the results may be obscured to an unknown degree by a part-whole relationship.

In Table 3 it is seen that three of the four tests which contribute to Factor C, though to a nonsignificant degree, prove to be intelligence test measures. Two of these, Beta *IQ* and the Wechsler Vocabulary make a positive contribution while the Gottschaldt Embedded Figures is negatively loaded. Rokeach's D Scale is the only attitude or personality measure other than the Famous Sayings Scale which contribute at all to this factor. H-T-P, the Bender Drawings, and all of the MMPI scales are notably lacking. In view of the usual description of hysteria one would expect that at least this one MMPI measure would have made a contribution, that is, if hysterics tend to be suggestible and accept the world in an uncritical fashion.

If we take the other approach and assume that these scales are measuring general social attitudes which have a variety of sources, we are at a loss to account for the positive contributions made by the Wechsler Vocabulary and the Beta *IQ*. The clue here may be that the Beta *IQ* and Gottschaldt Embedded Figures make contributions in the same direction on Factor A but they have opposite directions on Factor C. That is, it requires a modicum of intelligence to express an awareness of conventional mores but beyond a certain point, the ability to analyze and abstract may make one more critical of middle class values. In effect, one of the hypotheses which emerges from this analysis is that there is likely to be a curvilinear relationship between the four Famous Sayings scales and intelligence. This might be labelled a "Social Conformity Factor."

Three of the four scales which have the highest numerical loadings on

TABLE 7
FACTOR D

No.	Variable	Loading	Old Normals	Significant r_{pt}		
				Psycho- somatics	Organics	Psychotics
10	MMPI, L Scale	.694	—	—	—	.275
12	MMPI, K (fake- bad)	.639	.368	.324	—	—
39	MMPI, Ego	.549	.458	.374	—	—
38	MMPI, Work Attitude	.312	—	—	—	—
36	SNB	.327	.429	.595	.369	.595
11	MMPI, F Scale	—402	.472	.283	—	—
21	MMPI, Manic	—301	.375	—	—	—
27	Beta, Test 5	—338	.394	.292	.447	.291

Factor D suggest a denial of psychological difficulties: MMPI scales L and K load positively while the F scale has a negative loading. This tendency to denial may be supported by the positive loading of the MMPI Ego Scale, perhaps, the more so since the means for all the groups are so low. This interpretation is reinforced by the loading of the MMPI, Manic scale on the factor. The loadings for Beta, Test 5 which asks the subject to fill in the missing part of a drawing, and for SND which demands a perceptual discrimination, might suggest that this denial is only partially a matter of "faking good"; there is also a genuine inability to perceive lacks of imperfections in one's own performance. It is almost as though there is more concern about how one is seen by the examiner than in the test performance as such. This contrasts both with Factor A, where the capacity to follow directions is emphasized; with Factor E, which reflects task orientation; or with Factor F, the capacity for alertness. It seems not to be an alteration in capacity reflected in this factor but rather an orientation to the test situation in terms of putting one's best foot forward. This might be called a "Denial Factor."

TABLE 8
FACTOR E

No.	Variable	Loading	Old Normals	Significant r_{pt}		
				Psycho- somatics	Organics	Psychotics
33	Bender (Behavioral Efficiency)	.622	.449	.454	—	—
32	Bender (Mental Health)	.618	.389	.298	.313	—
30	H-T-P (Mental Health)	.350	.313	.401	—	—
42	MMPI, Morale Loss	— .368	—	—	—	—

Factor E is dominated by the Behavioral Efficiency and Mental Health scores of the Bender-Gestalt, and may be confounded in some degree by the fact that these two scores are based on the same test performance, producing a form of experimental dependence. However, the factor seems to have a meaningful interpretation in terms of the carefulness, effort, and desire to do well reflected in the high positive loading for the Bender when sorted for Behavioral Efficiency. This frame of reference easily accounts for the significant negative loading of the MMPI, Morale Loss, and perhaps the carefulness and concern for the opinion of others reflected by the positive but nonsignificant loading of the MMPI, Pa Scale (see Table 3). Despite

this slight orientation toward others which may reinforce a task orientation, the factor as a whole appears to be one reflecting motivations to perform well; the emphasis being on the performance rather than another person's evaluation of it as was the case in Factor D. Factor D might be thought of as an examiner-oriented response set, i.e., a person with a high Factor D score would be motivated to make an impression on the examiner while the person with a high Factor E score would be more concerned about mastering the task, per se. This factor is therefore named a "Careful Effort Factor."

The difficulties in this interpretation lie in the absence of some of the Beta subtests, especially Test 4, which is a very difficult one of spatial relations. It may be that this test is, in and of itself, too difficult to reflect only an attitude of carefulness and the desire to do well.

TABLE 9
FACTOR F

No.	Variable	Loading	Old Normals	Significant r_{pt}		
				Psycho- somatics	Organics	Psychotics
35	Critical Flicker Frequency	.593	.556	.289	.387	.268
36	Shortest Notice- able Dark Time	.549	.429	.595	.369	.595
1	Age	.477	—	—	—	—
25	Beta, Test 3	— .358	.827	.858	.756	.506

The authors consider this factor to be of particular significance in a study of behavioral deficit. The factor probably represents alertness or in the situation of suspected deficit, the absence thereof. CFF, SND and Age have positive loadings while Beta, Test 3 has a significant negative loading. One may have expected a positive loading on Famous Sayings Test, Social Acquiescence; on the Total Beta and its subtest 4, as well as the Gottschaldt Embedded Figures if this were alertness in a general sense. This factor appears to represent a "Sensory Alertness" or the ability to adopt anticipatory set.

It is of considerable interest that this is the only factor to which age contributes to a significant degree. This might suggest that the correlations in the original correlational matrix showing relationships between age and other measures are explained to the degree to which the performance on these other measures requires the adoption of an anticipatory set, to maintain attention for a significant length of time, or to make a clear discrimination of discrete sensory events. The factor is not characteristic of any particular type of deficit.

TABLE 10
FACTOR G

No.	Variable	Loading	Old Normals	Significant r_{pt}		
				Psycho- somatics	Organics	Psychotics
31	H-T-P (Behav- ioral Efficiency)	.645	.435	.516	.261	—
32	H-T-P (Mental Health)	.511	.389	.298	.313	—

The two measures based on H-T-P performance are the only ones having significant loadings on this factor. As in the situation with Factor E, this finding may be produced by the fact that the doublet reflects two measures based on the same performance, and thus the factor may be an artifact of what Thurstone called experimental dependence.

TABLE 11
FACTOR H

No.	Variable	Loading	Old Normals	Significant r_{pt}		
				Psycho- somatics	Organics	Psychotics
15	MMPI, Hysteria	— .646	—	—	—	—
13	MMPI, Hypo- chondriasis	— .507	—	.322	—	—
34	Apparent Move- ment	.385	—	—	—	—

Factor H seems to be an anti-suggestibility factor. There are negative and significant loading for the Hy and HS Scale of the MMPI and a positive loading on Apparent Movement. Again, some of the interest in this factor comes from those measures which have nonsignificant but fairly high loadings; the MMPI Ego Strength Scale gives a positive loading while the Conventional Moers Scale of the Famous Sayings Test and the D Scale from the MMPI have negative loadings. In effect, the "neurotic triad" and a tendency to conventional moers load negatively on this factor. Thus there is a lack of anxiety, a good deal of self confidence, a little need to rely on the opinion of others. The factor may represent independent judgment, not in the purely intellectual sense, but as general personality function somewhat analogous to field independence. The difficulty with this interpretation lies in the absence of the Gottschaldt Embedded Figures and the other measures of field independence. It is probably safer to emphasize the negative interpretation, "Anti-Suggestibility."

TABLE 12
FACTOR I

No.	Variable	Loading	Old Normals	Significant r_{pt}		
				Psycho- somatics	Organics	Psychotics
21	MMPI, Manic	.437	.375	—	—	—
19	MMPI, Psycho- asthenia	.395	.505	—	—	—
18	MMPI, Paranoia	.350	.290	—	—	—
20	MMPI, Schizo- phrenia	.316	.633	—	—	—

It is difficult to determine whether this factor is one of disturbance in mentation or in behavior. That is, positive loadings on the Ma and Pt Scales from the MMPI might suggest either peculiarities in thinking or represent the behavioral aspects of these scales which are not represented in Factor B. This factor may represent the garrulousness and uncertain behavioral control most clearly seen in the older normal group. This interpretation is strengthened by the r_{pt} correlations based on the older sample. Thus, this factor appears to represent "Deviations in Behavioral Controls."

D. DISCUSSION AND CONCLUSIONS

Factor analysis uses the relationships among data to reorganize them according to certain mathematical criteria and thus provides the investigator with an opportunity to gain greater insight about the measures employed. In this study, factor analysis yielded nine psychological descriptive dimensions which supplement the initial fourfold etiological classification. Within the context of this tentative classificatory system, it may be possible to identify those areas in which an individual still functions adequately as well as those in which he demonstrates deficits.

At this point it should be noted that no factorially defined deficit is unique to any of our four etiological deficit groups. It would be legitimate to say that a factor could be identified with a particular etiological deficit if the tests which discriminate among the deficit groups (using r_{pt}) also dominate a factor. This does not occur. This implies two things: (a) with these measures (scored in this form) differential diagnosis is likely to be extremely difficult; and (b) the deficit groups are likely to demonstrate some kinds of behavioral difficulty in common.

Since heterogeneous deficit groups have so much in common at a behavioral level, it is not surprising that a few tests (Beta1, Beta 3, Beta 5, SND and Embedded Figures) seem to be extremely sensitive to deficit regardless of its source. It is somewhat disappointing, however, to note that none of

these tests dominates the factors on which they load. This suggests that there are sources of variance not extracted in this analysis which may account for superior sensitivity of these tests. These sources of variance probably lie outside the measurement universe of this study.

It is possible that better differentiation among etiological deficit groups could be made in terms of their response to attempts to modify the behavior epitomized by the factors. These attempts at behavioral modification might profitably be oriented toward the symptoms which are shared in common with other groups as well as toward etiological sources. The specification of conditions under which improvement occurs and the extent of the improvement might prove an aid in diagnosis. For example, many kinds of individuals demonstrate impairment in following directions for many different reasons. A "treatment" program designed to circumvent these difficulties through greater explication of expectations, more repetition, etc., might demonstrate differential responses among groups.

Here, as in some other studies, where age has been used as a measure in combination with other intellectual, attitudinal and personality measures (10, 5) age loads on only one factor. Unlike these other studies, in this one age did not dominate the factor. In itself this finding is of considerable interest but it also raises questions about systematic versus specific differences in studies of aging. It has been found, for example, that the factors extracted from Wechsler-Bellevue subtest intercorrelations are remarkably similar from age group to age group up to the sixth decade. In the later years the "memory factor" has many more subtests loading on it and thus reduces the loadings that these tests previously demonstrated on other factors. There is, then, an implication that a greater proportion of variance is systematically related to age. In the results of the present study, the systematic variance attributable to age can be identified in terms of "sensitivity to environmental change" which in turn may be based on physiological capacities. On the other hand, age differences have been demonstrated on measures which do not load significantly on this factor using the point biserial correlations, e.g., many of the MMPI scales which do not load on Factor F to a significant degree. These MMPI measures, even though they demonstrate age differences load on a variety of other factors. Thus, it would appear that age, like intelligence, may contribute both general and specific sources of variation in psychological phenomena.

E. SUMMARY

The numbers and variety of measures proposed for the evaluation of psychological deficit suggested a need for a multivariate investigation to

elucidate the interrelationships and degree of overlap among these measures. The multiplicity of bases for the deficits in psychological performance add further to the need for a taxonomic approach to the problem area.

Forty-two measures from both clinical and laboratory psychology were obtained from a heterogeneous sample representative of age differences, brain pathology, psychoses and neuroses of psychosomatic disorders. Nine factors were extracted and point biserial correlations on each measure computed in which each deficit group was compared against the young normals. Most of the factors were tentatively named and the implications for the taxonomy of deficits in psychological functions were examined.

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PERCEPTUAL LEVELING IN INSTITUTIONAL AND OTHER CHILDREN*¹

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A. PROBLEM

Performance on the Schematizing Test has been found, for adult Ss, to be related to performance on other perceptual tasks and to certain personality variables. Ss who rely chiefly on repression as a defense mechanism (2), or who follow a pattern of "self-inwardness" which emphasizes a retreat from objects, passive drifting, avoidance of competition or of active manipulation, self-abasement, and exaggerated needs for nurture (3) are typically "levelers" in visual perception, rather than "sharpeners."

Since personality traits similar to those of levelers are often found in children reared in institutions (1, 5) it seemed of interest to administer the Schematizing Test—a hidden pictures test shown by Smith and Klein (4) to be related to the Schematizing Test—and a personality test to children living in an orphanage, and to compare the data to those of home-raised children. Our hypotheses were (a) that the institutional children would show more leveling, poorer hidden picture scores, and more inward tendencies than the children living at home; and (b) that there would be a positive relation between scores on the three tests. The data support the second hypothesis but not the first.

B. PROCEDURE

1. Sample

Thirty Ss were tested in each group. The institutional children were eight to 14 years old, with a mean age of 11 years (all ages are stated to the previous birthday). They had first been separated from their parents from four months to 12 years earlier, between the ages of zero and 12 years, and the length of their stay in this institution ranged from a few days to more

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than four years. The children in the control group were tested in a public school in a low income area, where the socioeconomic background was presumably similar to that of the families of the institutional children. The age range of the control group was 10 to 12; the mean age was 11. No immigrant children were tested. There were six girls in the institutional group and 17 girls in the control group. IQ's were available for 23 of the children in the institution. All Ss were tested individually.

2. *Schematizing Test*

Twelve slides were prepared, each of which showed a black square on a white background. The length of side of the projected squares ranged from one to 12 inches, in steps of one inch. They were presented one at a time in series of five, beginning with the smallest. Each child was asked to judge in inches the length of side of each projected square. After the first series had been presented three times, the one-inch square was dropped out, without the child being informed, a six-inch square was added, and the new series was presented three times. This procedure was continued until a series of eight to 12 inch squares had been shown three times.

3. *Hidden Pictures*

Five large pictures were used, each of which contained several "hidden pictures." They were shown one at a time, with the following instructions for the first:

I am going to show you some pictures. The first one is a picture of Jack and the Beanstalk. In this picture there are hidden little pictures. For example, look at this picture of an apple. There are many hidden objects shown here. See if you can find an acorn.

If the child found the acorn, his time was recorded in seconds. If he did not, he was asked after 60 seconds to find another picture, and his time on the acorn picture was reported as 60 seconds. There were 36 specified hidden pictures.

4. *Personality Tests*

The Blacky pictures were shown to the institutional children, with the standard instructions. Ten children were very reluctant to tell stories, and they were given instead a blank sheet of paper and asked to draw a person. When the drawing was completed they were given another blank sheet and asked to draw a tree; then a third sheet on which they were asked to draw a house. Because of certain requirements of the New York City Board of Education, the Blacky pictures could not be administered to the control group.

All children of this group were therefore given the drawing test described above.

5. Scoring

a. Schematizing Test. The sum of the first 15 judgments was divided into the sum of the last 15 judgments. The quotient, multiplied by 100, was taken as the score. Accurate judgments would give a score of 333.3. Scores substantially lower represent lag or leveling; scores substantially higher represent sharpening.

b. Hidden Pictures. Total time for the 36 pictures, with 60 seconds assigned as the time for each failure, was taken as the score. (Note that in Table 2 we report speed, not slowness of response.)

c. Personality Tests. All records were scored blind by GRS on a 7-point scale. A rating of one represented marked use of repression as a mode of defense and marked self-inwardness (see opening paragraph for definition). A rating of seven represented the opposite. Comparison of the Blacky and drawing scores of the institutional children showed no marked differences between the means or distributions. Probably, therefore, the two tests are roughly equivalent.

C. RESULTS AND DISCUSSION

1. Comparison between Institutional and Control Children

Differences in mean scores between the institutional and the control groups were negligible (Table 1). This finding fails to support our first hypothesis; and we shall list and tentatively evaluate four interpretations.

TABLE 1
MEAN SCORES OF INSTITUTIONAL AND FAMILY BOYS AND GIRLS

Tests	Institutional			Family			Total	
	Boys N = 24	Girls N = 6	Total N = 30	Boys N = 13	Girls N = 17	Total N = 30	Boys N = 37	Girls N = 23
Schematizing Test	231.8	233.3	232.1	243.4	228.4	234.9	235.9	229.7
No. of sec. for hidden pictures	728.3	714.6	725.6	711.8	762.8	740.7	722.5	750.2
Personality score	3.23	2.83	3.15	3.54	2.79	3.11	3.34*	2.80*

* Difference between means of boys and girls is significant at .01 level.

1. The scores were not valid indicators of personality trends. This seems unlikely because of the correlations shown in Table 2.

2. The higher ratio of girls to boys in the control group balanced the leveling tendencies of the institutional group. This seems possible. There is evidence from other sources that girls raised in these surroundings are more

"self-inward" than boys. In addition, the sex differences in Table 1 tend to support this interpretation, though only the difference between personality ratings is significant.

3. Children of this background tend to respond in inhibited ways to tests administered in a school setting; thus while they are in school they act like institutional children. This also is possible. It is consistent with the low personality scores since 25 of the 30 home-raised children scored below the theoretical mean of four, and with the fact that 28 of the 30 children tended to lag on the Schematizing Test.

4. The effect of living in the Leake and Watts Children's Home was as favorable as family life. This also is possible. The pattern of life at the Home was made to resemble that of a family: children of varying ages lived, about ten to a cottage, with two cottage parents. Their daily routine of pleasures and chores was not unlike the daily routine of many normative homes. About half of the children had some psychotherapeutic treatment, and this also may have helped to lessen the tendencies to withdrawal that could otherwise be expected.

Since the data of the two groups fail to demonstrate that the institutional and family children were drawn from different populations, their scores are pooled in the following section.

2. Relation between Perception and Personality Tests

Three measures will be presented for comparison of Schematizing Test and personality scores. (1) The coefficient of correlation is in the anticipated direction but is low ($r = .122$). This may be due in part to the restricted range: for these 60 Ss, 56 of the scores on the Schematizing Test and 53 of the personality scores were below the theoretical mean. (2) Following Holzman and Gardner's methods of analysis, we note that five children were classed as extremely repressed and self-inward (personality scores less than two). All five scored below the mean of the group on the Schematizing Test. The binomial probability of this finding is .04 on a one-tailed test. (The range of their Schematizing scores was 144-213; the mean was 176.) (3) Continuing to follow Holzman and Gardner's general method, we divide the extreme cases, the eight children with the lowest and the eight with the highest Schematizing scores, into those whose personality scores fall above the mean of the group and those whose scores fall below. The resulting two \times two table gives a two-tailed $p = .06$ by the Exact Method. Thus the results are consistent with the hypothesis, and two of the three measures are suggestive statistically.

When parallel measures are employed for the hidden pictures test, we find: (1) the correlation with personality scores is in the anticipated direction and suggestive ($r = .275$; $p = .05$); the correlation with the Schematizing Test is positive but very low ($r = .073$). (2) Only two of the five extremely repressed or self-inward children have times longer than the mean of the group. This does not support the hypothesis. (3) The two \times two table of Ss with highest and lowest speeds, taken against personality scores, gives a two-tailed $p = .07$. The corresponding table of these Ss taken against Schematizing scores also yields a two-tailed $p = .07$. As anticipated, the low speeds are associated with lag on the Schematizing Test and with low personality scores. Thus four of the five measures are consistent with the hypothesis, and three are suggestive statistically.

3. *Relation of Test Scores to Intelligence and Life History*

For 28 of the institutional children there was a record of the age at which the child first left the parental home, and for 23 of these there was a statement of the IQ. (The mean IQ was 90.3, and the range was 66-140.) Table 2 shows the correlations of these measures, mental age and the three tests that were administered. Several points are noteworthy.

TABLE 2
COEFFICIENTS OF CORRELATION

	Speed on hidden pictures ($N = 60$)	Personal- ity score ($N = 60$)	Age at first leaving par- ental home ($N = 28$)	<i>IQ</i> ($N = 23$)	<i>MA</i> ($N = 23$)
Score on Schematizing Test	.073	.122	.379 $p = .05$	.297	.375 $p = .10$
Speed on hidden pictures		.275 $p = .05$	.338 $p = .10$	.533 $p = .01$	.670 $p = .001$
Personality score			-.038	.523 $p = .02$	.315
Age at first leaving parental home				.440 $p = .05$	.526 $p = .02$
<i>IQ</i>					.797 $p = .001$

The coefficient of .67 between mental age and speed on hidden pictures, and the coefficient of .38 between mental age and Schematizing score, indicate that the tests relate to intellectual level in this age group. Thus for children these perception tests may be inappropriate as measures of personality tend-

encies unless mental age is controlled—or unless intelligence test scores are considered indicators of leveling or sharpening.

The correlation of .32 between personality rating and IQ indicates either that the ratings were contaminated by judgments of intelligence (though if this were true we would expect a higher, not a lower correlation with mental age), or more probably that the brighter children from broken homes tend to be more outgoing, while the duller children from broken homes are more likely to retreat within themselves.

The correlation of .43 between IQ and age at first leaving parental home is clearly open to either the environmental or the nativistic interpretation. It is consistent with the argument that foster family or institutional care in the very early years tends to lower the score that a child makes on a subsequent intelligence test; but it is also consistent with the argument that, among families whose children are institutionalized, duller parents both tend to have duller children, and also tend to stop caring for them earlier. It is interesting that the age at which the children first were left by their parents bears no simple relation to personality scores. Both the highest and the lowest ratings of personality were obtained by children who had been at the Leake and Watts Children's Home less than two months, but who had first been separated from their parents several years earlier, when they were six-eight years old. The correlation of .38 between age at first leaving parental home and scores on the Schematizing Test may indicate, however, that children separated from their homes at a very early age tend toward leveling patterns in perception. This is consistent with the generally held belief that such deprivation has its most marked effect if begun at a very early age.

D. SUMMARY

The Schematizing Test, a hidden pictures test and a personality test were administered to 30 children in a cottage-type orphanage and to 30 children from a public school in a low income area. The mean age of each group was 11. Leveling on the Schematizing Test and slowness in finding hidden pictures were associated with each other and with personality tendencies toward self-inwardness and use of repression as a means of defense. As has been found by other investigators, the Ss who were most self-inward and who made most use of repression showed particularly marked lag on the Schematizing Test.

Both groups of children were preponderantly "levelers," and tended to have self-inward ratings; there were no marked mean differences between the two groups. For the institutional children there were moderately high, suggestive or significant positive correlations between mental age and good

performance on the perception tests, between IQ and personality rating, between IQ and age at first leaving parental home, and between age at first leaving parental home and performance on the perception tests. These findings indicate a relation between life history, intelligence, personality, and perceptual patterns.

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SEXUAL BEHAVIOR OF THE MOUSE AFTER LONG-TERM
AND SHORT-TERM POSTEJACULATORY
RECOVERY PERIODS* ¹

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A. INTRODUCTION

Beach and Jordan (1) have described sexual exhaustion and recovery in the male rat and comparable data have been provided by Beach and Rabedeau (2) for the male hamster. Males of both of these species were found to be capable of several ejaculations before the point of sexual exhaustion was reached. Sexual exhaustion was defined as failure to mount the female, in the case of the rat, or to gain intromission, in the case of the hamster, in a specified period of time. It was discovered that during the series of copulatory responses leading to exhaustion, ejaculations following the initial ejaculation were achieved in less time and with fewer intromissions than were required for the initial ejaculation.

McGill (4) has described the sexual behavior of three inbred strains of mice and noted that mice differ from rats and hamsters in that a single ejaculation normally terminated sexual behavior. Occasionally, however, after two or three hours rest, the male achieved a second ejaculation. More frequently a male attempted copulation and achieved a second ejaculation on the day following initial ejaculation.

The present report compares the sexual behavior of the mouse after short-term postejaculatory recovery periods of 28 hours or less, with the sexual behavior of the mouse after long-term postejaculatory recovery periods of 13 days or more. Based on the data obtained from studies of the rat and hamster, the prediction is that matings following short-term postejaculatory recovery periods should be preceded by fewer intromissions and should require less time to complete than matings following long-term postejaculatory recovery periods.

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B. METHOD

1. *Subjects*

The mice used in the present study were of the strains BALB/Crgl/c, DBA/2J, and a genetically mixed group.² Ten males of each strain were tested. The animals were between five and eight months of age when tested. All males had had from three to seven previous copulations,³ each of which was followed by at least two weeks of sexual inactivity.

2. *Apparatus*

Sexual behavior was observed while the animals were housed in transparent plastic cylinders 10 inches in diameter and 20 inches in height. The behavior was recorded by the use of a four-pen Esterline-Angus Operations Recorder. The signal magnets of the Recorder were activated by manually operated microswitches.

3. *Procedure*

Females were brought into estrus with injections of 0.035 mg of estrogen followed in 36 to 48 hours by 0.1 mg of progesterone.⁴ Sex tests were conducted from five to 12 hours after the progesterone injections. The animals were kept on a reversed light-dark cycle, with both light and dark phases 12 hours in length. Observations were made under normal room illumination between 9:00 A.M. and 5:00 P.M.

Males were given no opportunity for sexual activity for at least two weeks prior to the initial test. Males of a given strain were then placed in the observation cylinders, one mouse per cylinder, and allowed an hour of adaptation before the introduction of a female. Males which copulated were retested at periods of approximately one hour, three hours, five hours, and 24 hours after the initial ejaculation. All animals were then rested for 13 days before the tests were repeated. The second test sessions were followed by another 13-day rest period before the third and final test sessions.

C. RESULTS AND DISCUSSION

All males ejaculated at least once during each of the three test sessions. Table 1 shows the number of males of each strain which ejaculated a second

² These mice were purchased as an inbred strain, but, unfortunately, the supply laboratory later discovered that the strain had become contaminated by cross-breeding with another albino strain. Therefore, the genetic makeup of the animals in this group cannot be specified.

³ "Copulation," as used in this report, refers to the complete mating act including all mounts, intromissions, and the ejaculation.

⁴ The hormone preparations, Progynon B and Proluton, were generously supplied by Edward J. Henderson, Shering Corporation, Bloomfield, New Jersey.

time during any of the three test sessions and the total number of second ejaculations observed. In no case was a male observed to ejaculate more than twice in 24 hours. The mouse is obviously less "potent" than the rat or hamster in terms of the number of ejaculations per day. Further, the DBA/2 and the mixed strain males would appear to be somewhat more potent than the BALB/c males.

TABLE 1
NUMBER OF MALES WHICH EJACULATED TWICE IN ANY OF THREE 28-HOUR PERIODS AND
TOTAL NUMBER OF SECOND EJACULATIONS OBSERVED

Strain	No. which ejaculated twice	No. of second ejaculations
BALB/c	2	4
Mixed	4	10
DBA/2	5	10

Four behavioral measures were investigated in the present study. These were mount latency, defined as the number of seconds from the introduction of the female until the male mounts the female; the number of intromissions (mounts accompanied by insertion of the penis into the vagina) prior to ejaculation; the total number of thrusts prior to ejaculation (an intromission consists of from one to 300 or more pelvic thrusts); and the ejaculation latency, defined as the number of seconds from the beginning of the first intromission until the beginning of ejaculation.

Medians for these four measures for the short-term postejaculatory recovery periods were then compared with medians for the same animal for long-term postejaculatory recovery periods. The long-term medians were determined using the previous copulatory history of the animals, as well as the initial copulations of each test session.

The sign test (5) was applied to the 11 pairs of medians for each of the four behavioral measures. The mount latency medians were not significantly different. However, the number of intromissions prior to ejaculation, the total number of thrusts prior to ejaculation, and the ejaculation latency were all found to be significantly reduced by a short-term recovery period ($p = .01$, two-tailed).

The mouse is thus seen to be similar to the rat and hamster in that the initial ejaculation of a male who has been sexually inactive for some time is preceded by more intromissions and a longer ejaculation latency than are observed in a male who has recently ejaculated. However, the period of voluntary sexual inactivity following an ejaculation and the number of ejaculations possible per unit time differ in the three species. In terms of these

measures, the hamster is the most potent animal, closely followed by the rat, with the mouse the least potent of the three.

Figure 1 illustrates the magnitude of the differences in the sexual behavior following long-term postejaculatory intervals and short-term postejaculatory intervals in the mouse. In this case the long-term values represent the strain medians of 10 BALB/c males (a total of 58 copulations), 7 DBA/2 males (27 copulations) (+), and eight males of the mixed strain (+1 copulations) (3).

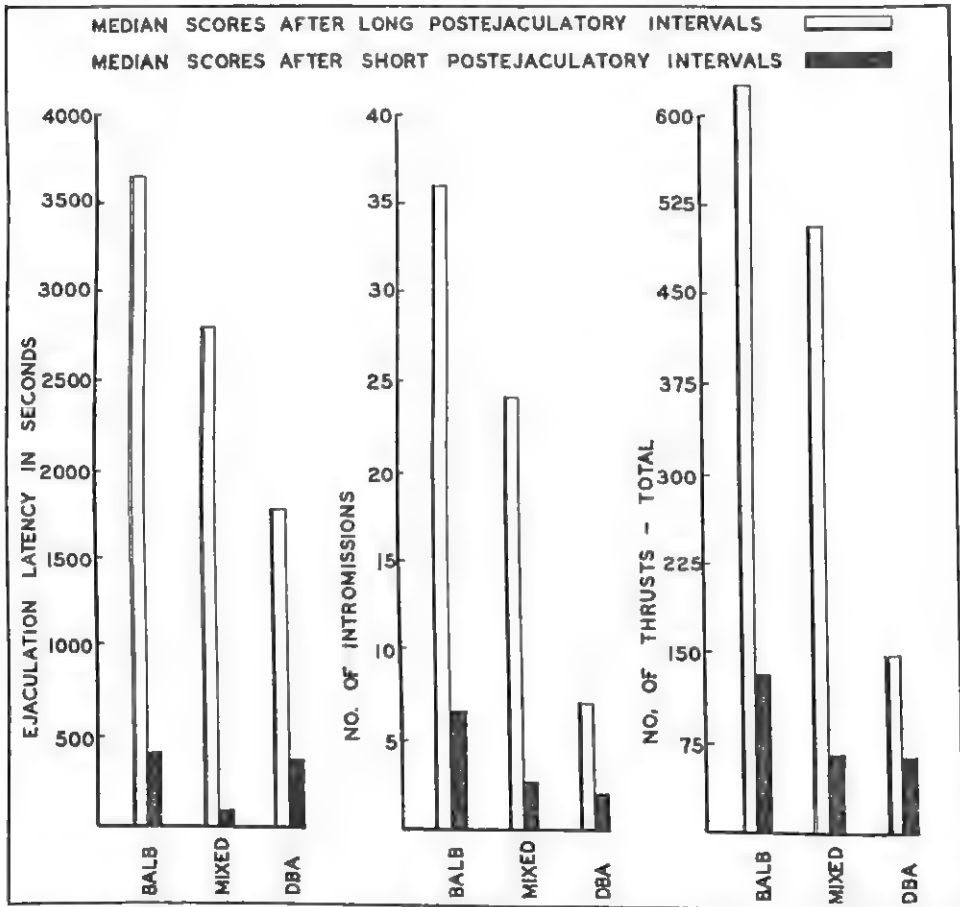


FIGURE 1
MEDIAN SCORES FOR THREE STRAINS OF MICE AFTER LONG-TERM AND SHORT-TERM POSTEJACULATORY INTERVALS

Figure 1 also illustrates some of the strain differences in "normal" (13 days or more postejaculatory recovery period) sexual behavior. For example, the

DBA/2 strain differs significantly from the other two strains on all three of the measures shown in Figure 1. The differences between the mixed strain and the BALB/c strain are not significant. Although present data are inconclusive on the point, the possibility exists that a short-term postejaculatory recovery period eliminates statistically significant strain differences for certain measures of sexual behavior.

D. SUMMARY

A comparison was made of the sexual behavior of three strains of mice after long-term postejaculatory intervals (13 days or more) with the behavior observed after short-term postejaculatory intervals (28 hours or less).

It was found that ejaculations following short-term postejaculatory intervals were preceded by significantly fewer intromissions and thrusts, and by a significantly shorter ejaculation latency, than were observed after long-term postejaculatory intervals. There was no difference in mount latencies.

The similarity of these findings to those for the rat and hamster was noted.

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PATTERNS OF ABILITIES AND CAPACITIES IN THE EPILEPTIC*¹

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Whenever we consider the ability patterns of any handicapped group, we must be aware of the numerous factors that can influence test results; for instance, lack of educational and occupational opportunities for the epileptic. With these and other limitations in mind (10, 18, 21), this paper will be confined to studies using the Wechsler-Bellevue Intelligence Test with noninstitutionalized epileptics who constitute the larger part of the epileptic population. Furthermore, there is general agreement in the literature that the *IQ*'s of institutionalized epileptics tend to be lower than the private or noninstitutionalized epileptics.

This test is especially well suited for the purpose as it is composed of 11 subtests² which tap the various facets of intellectual and motor functions in order to yield not only a score of global intelligence but also ability patterns, if any exist.

The second part of this paper will discuss the capacities of epileptics as reflected by their ability patterns in selective occupational placements and in job performance when given the chance for such. We will complete this presentation with a few guides to rehabilitation counselors who work with epileptics.

A. ABILITY PATTERNS

1. *General Intelligence*

(a) In studies (5, 6, 19, 28) investigating or reporting the *IQ* scores of epileptics, it has been found that they were the same as those found in the general population norms. "Therefore, no psychometric signs or patterns pathognomonic of epilepsy could be established in this area" (19, p. 614). (b) The fact that seizures and medications fail to depress mentality

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² The six Verbal subtests are Information, Comprehension, Digit Span, Arithmetic, Similarities, and Vocabulary. The five Performance subtests are Picture Arrangement, Picture Completion, Block Design, Object Assembly, and Digit Symbol.

is best shown by a study of 125 twins. "For example, in one 10-year-old identical pair, the *IQ* of the normal boy was 179, and the *IQ* of his epileptic brother was 182" (13, p. 534). (c) Those epileptics who go to public clinics, those whose epilepsy is due to brain injury, those whose age of onset occurred in early childhood, and those where there is demonstrable organic pathology all tend to have lower *IQ*'s than those found within the normal limits (6, 13, 19).

2. *Verbal-Performance IQ*

Possibly an *IQ* characteristic of the epileptic might be a higher Verbal *IQ* than the Performance *IQ* which was found in the studies of Collins (6) and in another by her with Lennox (5). In fact, this same finding has been reported in a study (1) with institutionalized epileptics. This finding is worthy of further investigation and research in order to determine whether or not it is an epileptic *IQ* characteristic.

3. *Subtest Scale Scores*

There are two studies which are relevant to this point:

1. Collins, who was interested in learning if there were any subtest score patterns, made a comprehensive study (6) of some 400 extramural, office patients with epilepsy whose ages ranged from 16 to 63 years, with a mean of 24.8. Among this group there were 228 adults aged 20 to 63, with a mean of 30.8, and 172 students whose mean age was 16.5. There were 178 male and 222 female subjects.

She broke down this sample into various groups, such as by age, types of seizures, etc., for some patterns. She concluded:

We have found a fairly distinct pattern of subtest records that characterizes all of our many groups, with only minor variations. This pattern consists, in general, of three distinct groupings: (1) the four verbalized tests and Block Design, (2) the other four performance tests, and (3) the low-rating Digit Span and Arithmetic. There is some intragroup variability in these groupings in our various classifications, but few intergroup shifts. The few variations from this pattern were chiefly in the traumatic cases, those whose seizures were of the psychomotor type, the groups of lowest intelligence, and those with the most marked dysrhythmia. Comprehension is the highest-ranking subtest in all groups. A feature of the traumatic-genetic comparison is the significant drop of Block Design in the brain-injured cases (6, p. 398).

It is interesting to note that Collins found the male subjects had significantly higher scores on the Arithmetic and Information subtests whereas the female subjects had significantly higher Digit Symbol scores. Another con-

clusion of this study was that "Anxiety, naturally engendered by the liability to seizures, might be a determinant of some features of the rather consistently observed pattern of response in our group" (6, p. 398).

Some social and environmental causes have already been mentioned in the introductory paragraph.

2. Sands and Price (19) did a pattern analysis of 77 cases who had been discharged after hospitalization. These were divided into three groups: among the idiopathics there were 35 without personality problems (referred to as epilepsy) and 23 with personality problems. The mean age was 24.4 for the first group and 28.7 for the second. The third group of 19 symptomatics had a mean age of 28.6.

These investigators concluded that neither of the idiopathic epilepsy groups were significantly different in subtest scores from each other as well as from the general population norms. This finding was similar to an earlier study of Collins and Lennox except for the picture completion subtest. However,

The lower level of intellectual functioning and the different distribution of the subtests differentiates the organic group from the epilepsy and personality problems group, and also from the normal controls. The organic group significantly differed from the normal control group on digit symbol (19, p. 614).

Impairment in the digit symbol subtest was considered by Wechsler to be a characteristic of organicity (24, p. 217).

4. *Mental Deterioration*

In view of the findings of the researchers under general intelligence, it is not surprising to find the studies in agreement as to little evidence of deterioration in epileptics, barring normal mental deterioration, except in those cases which are organic.

B. CAPACITIES

1. *In Selective Occupational Placements*

In keeping with their capacities as reflected by their ability patterns as well as other factors, the epileptics have been educated, trained, and employed in a wide range of occupations as revealed by two recent studies of national scope: (a) The first study (15), carried on under the auspices of the Veterans Administration, Department of Veterans Benefits, has as its subjects veterans of World War II and the Korean Conflict. Among 742 "Occupational Summaries" and case history briefs presented, veterans had been

trained and employed in a diversified range of jobs as may be seen from Table 1. (b) In another study (23) prepared by the Department of Health,

TABLE 1
A BREAKDOWN OF THE MAJOR OCCUPATIONAL GROUPS AFTER REHABILITATION
OF 742 VETERANS OF WORLD WAR II AND THE KOREAN CONFLICT

Occupational category	Number	Per cent
Professional, Technical & Managerial Work	178	23.9
Clerical & Sales Work	201	27.0
Service Work	26	3.5
Agricultural, Marine & Forestry Work	48	6.4
Mechanical Work	163	21.9
Manual Work	126	16.9

Education, and Welfare, Office of Vocational Rehabilitation, a breakdown of 1,521 major occupational groups of rehabilitated epileptics throughout the U.S. were reported. These are given in Table 2.

TABLE 2
A BREAKDOWN OF THE MAJOR OCCUPATIONAL GROUPS AFTER REHABILITATION
OF THE 1,521 EPILEPTICS

Occupational category	Number	Per cent
Skilled & Semiskilled Workers	391	25.7
Clerical, Sales, & Kindred Jobs	389	25.6
Service Workers	268	17.6
Unskilled Workers	146	9.6
Family Workers & Homemakers	122	8.0
Agricultural & Kindred Workers	116	7.6
Professional, Semiprofessional, & Managerial Occupations	89	5.9

Note: Ninety-one or 6.0 per cent of the 1,521 persons rehabilitated were self-employed.

2. In Job Performance

In intensive studies (17, 18) carried on in the industrial workshop by the Epi-Hab Center of Los Angeles, California, it was found that "a total time of 425 hours were lost out of 475,000 man hours worked, or approximately one hour out of every 1,000 hours worked, an insignificant loss" (25, p. 36). The Epi-Hab Centers in the states of Arizona, New York, and Wisconsin are also in the process of achieving such results. Equally significant is the statement made by the Ford Motor Company of Detroit: "Accidents are so low among the epileptics that (they) would not convey any data worth looking at. . . . Out of 165 epileptics over a period of many years, we do not have one accident case worth mentioning." This is not surprising when the epileptologist knows that seizures can be controlled

through proper medication. Of course, an epileptic may injure himself while away from his work but again "the accident rate of epileptics working in all lines of industry does not suggest that they are injured any oftener than anyone else" (12, p. 16). Furthermore, according to the Association of Casualty and Surety Companies, insurance rates and compensation awards are not dependent on whether or not handicapped workers are employed (7).

C. PRACTICAL APPLICATIONS FOR COUNSELORS

On the basis of the information contained in this paper and the experience of this counselor in working with a number of epileptics, the following are a few cues which are presented as guides for counselors:

1. The necessity of evaluating the *whole* person in terms of abilities, capacities, and other pertinent personality and personal information about the epileptic can hardly be emphasized enough so that competent professional services may be rendered (26) in regard to training and employment.³
2. The importance of considering how the epileptic uses compensation and overcompensation in the selection of an occupation (2) so that his capacities for education and work will be in keeping with his actual and potential abilities.
3. Whenever needed, the amount of counseling (25) or psychotherapy (3) should be proportional to the degree of prejudice to which the epileptic has been and is exposed (4).
4. Medical certification (20) in the 50 United States can be encouraged by attesting to the employability of the epileptic in order to reduce or eliminate unnecessary fears and prejudices now keeping epileptics from realizing their full potential.
5. The publication of studies and articles about epileptics which would be helpful in disseminating information among the professionals⁴ (8, 9, 14), and which would also be helpful in educating those with whom the epileptic might come into contact⁵ (11, 16, 27).

³ In addition to the other publications by the Government Printing Office already given in Reference 2, another useful one for the counselor is the "Occupational Outlook Handbook"; Washington, D.C.: G.P.O., 1959. Equally important is the favorable position taken by the United States Civil Service Commission in regard to the employment of epileptics (see Reference 22).

⁴ Besides the works cited in References 2, 14 & 15, see G. N. Wright, "Epilepsy Bibliography: January, 1956 to January, 1960"; Chicago, Ill.: National Epilepsy League, 1960.

⁵ A few such reprints from popular magazines are: J. Andrews, We learned to live with epilepsy; *Parents*, Jan. '53. P. de Kruif, They're beating the devil out of epilepsy; *Reader's Digest*, Jan. '53. H. G. Rusk, The epileptic: A useful human being in need of a break; *Look*, Jan. '59. E. R. Wilson, The child who is different; *Parents*, March '58.

6. Using the information which is made available free through various interested societies and associations working with epileptics⁶ and also acquainting epileptics with the value of becoming members of such groups.⁷

7. The continuation of meetings at the local, state, and national levels⁸ for the purpose of exchanging ideas among the professionals and planning programs to inform the public about the facts of epilepsy.

D. SUMMARY

This paper has strongly indicated that the problem which the epileptic faces is not one of his abilities, capacities, or potentialities, since he compared favorably with the general population in terms of his intellectual level, education, training, and work experience, which lends support to the theory that there is no "typical" epileptic. Instead, his problem is one of prejudice, fear, discrimination, and ignorance on the part of the public with whom the epileptic comes into contact whether at home, at school or at work, and even the law discriminates against him. However, it is hoped that those of us who have any contact with epileptics will do everything we can to break down the epileptic barrier, so that epileptics are encouraged and given equal opportunity for education, training, marriage, raising a family, and employment with opportunity for advancement. Epileptics are equally as capable of achieving in these areas as any other persons. The counselor, by cooperating with professionals from other disciplines as part of a rehabilitation team, can greatly assist the epileptic in preparing him to achieve realistic goals in life—socially useful goals according to his assets.

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⁷ A helpful adjunct in assisting the counselor as well as the epileptic is the Newsletter published by the organization of which he might become a member; for instance, *Horizon*, National Epilepsy; or *Epilepsy News*, United Epilepsy Association. Films are also available such as "Mr. Citizen" and "Boy In a Storm." Addresses have already been given in Footnote 6.

⁸ For those interested in epilepsy or working with epileptics see the publication resulting from the First National Institute on Epileptic Rehabilitation held at Chicago, May 25-27, 1960: "Total Rehabilitation of Epileptics: Gateway to Employment"; Washington, D.C.: GPO, 1962.

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A MODIFICATION OF THE EMBEDDED-FIGURES TEST FOR USE WITH YOUNG CHILDREN*¹

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A. INTRODUCTION AND PROBLEM

Studies reported by Witkin, Lewis, Hertzman, Machover, Meissner and Wapner (4) suggest that people can be characterized quite generally along a dimension of functioning reflecting an analytical versus a global approach to the world. This dimension is expressed in perceptual functioning and has been most thoroughly studied through measures of field dependence, defined as the ability to overcome an embedding context in perception.

Since the tests of field dependence currently available were not developed for use with young children, this work has been limited to children above the age of eight. In many ways, however, the study of younger children might be particularly profitable.

Witkin *et al.* have demonstrated a developmental trend in perceptual style from eight years of age to young adulthood, progressing from a relatively global approach to a more analytical approach. Longitudinal studies of development have also demonstrated substantial correlations between test and retest from eight to thirteen and from ten to seventeen years of age suggesting that an individual's characteristic approach to the world is largely determined by the age of eight. It is also clear that the course of this development is related to patterns of mothering (2, 3).

These findings raise questions about the early origins of style of field approach and, therefore, suggest the need for studying field dependence in younger children. In the studies reported here first steps in this direction were taken by developing a test of field dependence suitable for use with young children.

The embedded-figures test has been the most widely used measure of field

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¹ The studies reported here were supported by U.S.P.H.S. Grant No. M-628 under the general direction of Dr. H. A. Witkin. We are greatly indebted to Dr. Lois Murphy, Dr. Grace Heider, and the staff of the "Coping Project" (The Menninger Foundation) for their invaluable contribution in the data collection phase of the Topeka study. We are also indebted to Drs. Biber and Shapiro of the Bank Street School, New York City; to Dr. Shuey of the Brooklyn College Nursery School; and to Miss Cohen of P.S. 152, Brooklyn, N.Y., for their help in contacting and scheduling subjects.

dependence in adults. This test makes use of modified Gottschaldt figures in which the *S* is required to find a simple geometric form embedded in a complex, geometric figure. Twenty-four items are included in the full test, the score being the mean time required to locate the simple forms. The embedded-figures test is much too difficult for *Ss* below the age of ten, however. Contributing to its difficulty is the fact that it holds no intrinsic interest for young children. Furthermore, the time score is suspect in young children whose attention often wanders from the test. Therefore, any variation in performance on the test among young children may reflect individual differences in motivation and/or capacity to concentrate on the test to a much greater extent than is true for adults.

In the studies reported here an attempt was made to modify the embedded-figures test for use with children between the ages of five and nine. Specifically, an effort was made to develop a test which would meet the following requirements: (*a*) have intrinsic interest for children; (*b*) be presented in a way which will insure understanding of the task requirements; and (*c*) be a power instead of a speed test.

B. PROCEDURE

1. *Development of the Test Format*

Normal children between the ages of five and ten were used as *Ss* in a series of exploratory studies in which procedures and format for the children's form of the embedded-figures tests (CHEF) were developed. The general test format that emerged from these studies is described below.

As in the adult form, the CHEF is composed of a series of items which require the *S* to find a simple form in a complex figure. In the adult version of the test the complex figure is a meaningless geometric figure. In the CHEF, however, meaningful complex figures are used in order to make the procedure more attractive to the children, and in order to insure that the complex figure is initially perceived as a whole. Each complex figure is a picture of a familiar object such as a car, man, or boat, appropriately colored and easily identified by the *Ss*. In the most recent version of the CHEF, 20 items are used containing one of three simple forms: a square, kite, or house. The house form is shown in Figure 1A. A sample picture is presented as Figure 1B.

In order to make the task more concrete and interesting, the pictures are painted on a 21-inch-square masonite board, giving the appearance of a giant jig-saw puzzle. A knob is located at the center of the simple geometric form which is to be found by the children. In Figure 1B, for example,

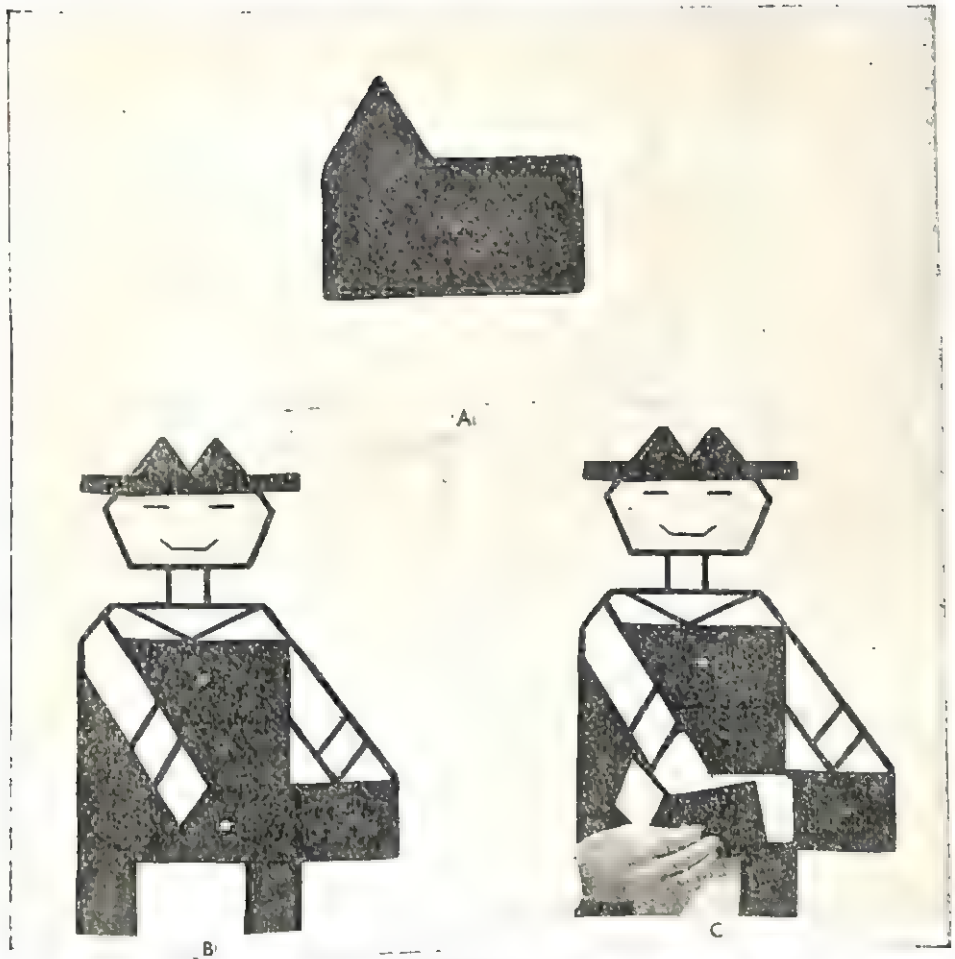


FIGURE 1
A SAMPLE CHEF ITEM

a knob is located at the center of the house. If this knob is pulled by the *S*, the simple form can be physically removed from the board like a piece from a jig-saw puzzle (see Figure 1C). On the back of the simple form is a picture of a teddy bear which makes the test more gamelike and is useful when referring to the simple form as the game is explained to the *S*. Knobs are also located at the center of incorrect alternative forms which *cannot* be removed when the knobs are pulled.

During the testing the *S* is seated about eight feet from a stand on which the boards are displayed at the *S*'s eye level. The *S* is first asked to identify the correct simple form from his seat. After he has made his choice he goes

to the board and pulls the knob which he has chosen. In searching for the correct simple form (and the teddy bear) the *S* is always allowed to correct his mistakes, the score being the number of items on which the correct knob is pulled first. This procedure avoids all requirements for speed and minimizes any frustration which may occur as a result of repeated failure.

As part of the initial instructions for the CHEF, a test of form discrimination is administered. The form discrimination test is included to make the instructions concrete and to insure that each *S* can distinguish between the correct simple form and the incorrect alternatives when these forms are not embedded in the complex figures. The *S* is shown the first simple form (square) and then asked to choose between the square and three incorrect alternatives. Additional discrimination problems are given until the *E* is satisfied that the *S* is able to make correct choices on the basis of form alone.

Following the form discrimination problems, the *S* is given two sample items containing the square as a simple form. The series of test items containing the square is then administered. This general procedure is repeated for the series of items containing the kite as a simple form, and again for the house items.

2. Relationship to Standard Tests of Field Dependence

In order to determine the extent to which the format used in the CHEF reflects individual differences in field dependence, eleven items were initially developed and administered to a group of 30 ten-year-old boys who were participating in another study (1, 3). These *Ss* were given the standard battery of tests used to measure field dependence. In addition to the embedded-figures test, this battery included the rod-and-frame test and the body-adjustment series of the tilting-room-tilting-chair test (4).

TABLE 1
CORRELATIONS BETWEEN THE CHEF AND STANDARD TESTS OF FIELD DEPENDENCE

	Rod-and-frame test	Body-adjustment test	Embedded-figures test
CHEF	.70**	.46*	.63**
Rod-and-frame test		.59**	.68**
Body-adjustment test			.60**

* $p < .05$.

** $p < .01$.

As can be seen from Table 1, the CHEF was highly related to the standard tests of field dependence at the 10-year level.

C. RESULTS

1. *Item Analysis, Sex Differences, and Developmental Trends*

The results of the 10-year-old study clearly warranted further refinement of the CHEF. Twenty-nine additional items were therefore developed, in an effort to improve the test, bringing the total to 40 items. The 40 items were then subjected to an item analysis, using the total CHEF score as a criterion.

Since a 40-item test is too long for children, the total item sample was divided into two sets of 20 items. One set was selected by drawing 20 items at random from the total. The remaining items formed the second set. This procedure was repeated 12 times to obtain 24 different tests of 20 items each. For each test the order of administration of all items containing the same simple figure was also randomly determined so that item-difficulty statistics could be meaningfully interpreted.

Data from 48 five-year-old and 48 eight-year-old public school children, divided equally between the sexes at each age, were used for the item analysis. These *Ss* were contacted through a public school located in Brooklyn, N.Y. The *Ss* were drawn at random from among the children of the appropriate age who volunteered, and whose parents provided written consent for participation in the study. Each of the 24 tests was given to one *S* from each of the four experimental groups (male and female five-year olds and male and female eight-year olds).

The 20 items which had the highest relationship with total CHEF score were selected for the current version of the test.

Although this study was conducted in order to refine the CHEF, the design also permitted an evaluation of developmental trends and sex differences in the five- to eight-year age range.

As can be seen from Tables 2 and 3, no significant sex differences in CHEF performance appeared at these ages. The ability to overcome an embedding context clearly increases from five to eight for both sexes, however ($F = 43.77, p < .001$).

TABLE 2
MEAN NUMBER OF ITEMS FAILED BY AGE AND SEX

Sex	Age	
	5	8
Male	7.5	3.8
Female	7.3	3.6

TABLE 3
ANALYSIS OF VARIANCE

Source	df	Variance estimates
Age	1	330.04
Sex	1	.66
Test	23	5.66
Age \times Sex	1	<.01
Age \times Test	23	7.54
Sex \times Test	23	7.38
Age \times Sex \times Test	23	6.33
Total	95	

Note: $F_{age} = 43.77$; $p < .001$.

2. Reliability

Estimates of the reliability of the CHEF, based on the data from the study reported above, would be meaningless since the method of item selection must spuriously increase the internal consistency of the test in this sample. In connection with another study, however, the CHEF was given to 200 children, 25 males and 25 females at six, seven, eight and nine years of age, drawn from the public and parochial schools of Topeka, Kansas.² These data were used to study the reliability of the CHEF.

Reliability coefficients, computed by the Kuder-Richardson formula 20, and standard deviations are presented in Table 4 for each age-sex group.

TABLE 4
CHEF RELIABILITY COEFFICIENTS AND STANDARD DEVIATIONS BY AGE AND SEX

Age	Sex			
	Male		Female	
	<i>r</i>	σ	<i>r</i>	σ
6	.74	3.8	.62	3.2
7	.58	3.0	.78	3.8
8	.80	3.9	.58	2.9
9	.82	3.9	.74	2.9

D. DISCUSSION

Extensive experience with the CHEF format leads us to believe that the test is intrinsically interesting to almost all children of the ages studied. An examiner who is experienced in dealing with children can usually keep the child happily working at the problems for the half or three-quarters of an hour required for the completion of the test in its present form.

² This study will be reported more fully in subsequent papers.

We also believe that the format permits an experienced examiner to present the instructions with little room for misunderstanding. The format allows the examiner to evaluate the testability of the S, but we have had few Ss who were untestable because they were unable to understand the instructions or unable to discriminate between the isolated simple forms.

From these points of view the CHEF format seems promising. In fact, preliminary work suggests that many disturbed children and children below the age of five may be testable.

The reliability of the present version of the CHEF is not as high as would be desirable. No doubt the reliability can be improved, however. For example, considerable time could be saved by altering the design of the equipment, which now makes the test cumbersome to administer. The reduction in administration time would make it possible to increase the number of test items.³ In its present form the CHEF reliability is probably adequate for research purposes.

The relatively high and significant correlations between the CHEF and standard, perceptual tests at the 10-year-level suggest that the CHEF is an adequate measure of field dependence at that age.⁴ This finding does not guarantee that the CHEF is a good measure of field dependence at younger ages, of course. Further evidence on this issue must come from longitudinal studies and from studies in which the relationships between CHEF performance and other variables are determined for young children. The data reported here suggest that it may be fruitful to conduct such studies with the present version of the CHEF.

E. SUMMARY

A modified version of the embedded-figures test was developed for use with children between the ages of five and nine. The children's test was related to the adult form of the embedded-figures test and to other measures of field dependence among 10-year-olds. The test reliability although modest, appears adequate for research purposes.

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³ Since this paper went to press, a revised version of the CHEF, called the CEFT, which has achieved some of these objectives and which has better reliability than the CHEF, has been developed at this institution by S. A. Karp and N. Konstadt.

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USEFULNESS OF THE LOWENFELD MOSAIC TEST IN
PREDICTING SCHOOL READINESS IN
KINDERGARTEN AND PRIMARY
SCHOOL PUPILS*¹

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A. INTRODUCTION

The aim of the present study was to determine whether or not the Lowenfeld Mosaic test might prove useful in predicting school readiness or unreadiness in children just starting kindergarten and the early primary grades. To determine this, we have analyzed Mosaic responses of a sizeable group of beginning kindergarten, first and second grade subjects over a three-year period, noting whether the Mosaic response of any given individual remained consistent over a period of years; whether or not evaluations of children's Mosaic responses agreed with evaluations of their responses on other types of readiness tests (developmental, visual); and also noting correspondence or lack of correspondence between teachers' evaluations of readiness with results obtained from use of the Mosaic.

Data for the present study were gathered as part of a more comprehensive investigation of school readiness. Subjects were examined by three examiners, Frances L. Ilg, M.D., Richard J. Apell, O.D., and Louise B. Ames, Ph.D., who gave, respectively, a modified developmental examination, a fairly detailed visual examination, and the Rorschach and Mosaic tests. In addition, the WISC, both verbal and performance scales, was given to the majority of subjects.

B. SUBJECTS AND PROCEDURE

1. *Subjects*

All subjects for the present study were students at the Hurlbutt School, Weston, Connecticut, during the period from September, 1957, to December, 1960. Originally included were the entire kindergarten population (81 children), one first-grade class (22 children), and one second-grade class (29 children). A few children were lost each year as they moved out of

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this school district. Data given here as to intelligence and father's occupation pertain to the entire group of children originally tested.

All subjects except the original second-grade group were examined four times: in the fall of 1957, spring of 1958, fall of 1958, fall of 1959. The second-grade group was examined during the fall terms of 1957, 1958, 1959 and 1960. Though ages of subjects varied somewhat within any given class, for the most part the kindergarten subjects were 5, 5½, 6 and 7 when examined; the original first-grade subjects were six, seven and eight; the original second-grade subjects were seven, eight, nine and 10 years.

The Hurlbutt School is a public primary school. The majority of subjects for this study fall in the high average category of intelligence, or above, as follows: Mean *IQ* for the 60 kindergarten subjects for whom we have an *IQ* score is 111.15; mean for the 21 original first graders tested is 105.80; mean for the 23 original second graders on whom an *IQ* score is available is 108.18.

Most subjects came from professional or semiprofessional families, as appears evident in Table 1.

TABLE 1
SOCIOECONOMIC DISTRIBUTION OF SUBJECTS: NUMBER OF RECORDS AT EACH LEVEL
OF MINNESOTA SCALE OF PATERNAL OCCUPATIONS

Class	81 Kinder- gartens %	28 First Grades %	31 Second Grades %	Total (140) %
1. Professional	14	21	16	16
2. Semiprofessional managerial	44	46	45	45
3. Clerical, skilled trades, retail business	27	11	16	21
4. Farmers	0	0	0	0
5. Semiskilled, minor clerical, minor business	5	11	7	6
6. Slightly skilled	1	11	3	4
7. Day laborers	1	0	0	1
No data	6	0	13	6

Both materials and method of administration of the Mosaic test are described in full in an accompanying paper (2) as well as in our book publication on this test (1).

2. Procedure

Original kindergarten and first-grade subjects were examined four times

each, as indicated above, first after an interval of six months and then at yearly intervals. After each full set of examinations was finished, the three examiners conferred and evaluated each subject as + (ready for the grade he was in and ready for full promotion the following year); \pm (questionably ready); — (not ready). Indication was also made when a child seemed to need to be in a special class; and many intermediate ratings such as $+\pm$ or $\pm-$ were given.

At the end of each year, teachers were asked to rate subjects as 1 (ready), 2 (questionable), 3 (not ready). These yearly ratings by teachers were not consulted by us until all examination data had been gathered. They were then compared with our own findings. All of these comparative findings will be reported in our group publication which will cover all readiness tests tried out (5). The present paper discusses the Mosaic findings in greater detail than was feasible in the joint publication.

Analysis of Mosaic data was somewhat subjective. All Mosaic products were first classified as unpatterned nonrepresentational, patterned nonrepresentational, or representational (with several subheadings under each main classification) in accordance with a system of classification reported in an earlier study (1).

Then, taking into consideration this classification but also using considerable subjective judgment, we arranged Mosaic products for each group (each of four kindergarten classes, original first grade, original second grade) in rank order from best (or most effective or most mature) to worst (least effective or least mature) for each of the four separate examinations.

Then, finally, Mosaic findings were compared with those of the other examiners and with teachers' judgments as indicated below.

C. FINDINGS

The expectation that the Lowenfeld Mosaic test will be useful as part of a battery of tests designed to determine school readiness appears to be based on at least three assumptions. First, it must be assumed that the child's response to the Mosaic test, as to other tests, develops in a somewhat patterned, orderly fashion so that it is in general possible to identify a characteristic five-year-old type of response, a six-year-old type of response, etc. If this can be done, then presumably it would be possible to arrange the products of subjects in any given group in rank order from best (or most effective or most mature), to worst.

Second, if the Mosaic is to be useful in arriving at any judgment about school readiness, any given child's response should remain more or less con-

sistent (within the group) as to its relative rank order. For the test to have predictive value a child who does well on the test at one given time should also be expected to do well on a subsequent administration; the child who does poorly should be expected to continue to do somewhat poorly. That is, allowing for normal uncertainties of rate of development, there should be predictive value to any given single Mosaic response.

Third, to be useful as part of a school-readiness battery, the Mosaic response should agree to a reasonable extent with responses to other tests given in indicating readiness, unreadiness or questionable readiness, and also with teachers' evaluations of actual school performance.

1. Developmental Stages in Mosaic Productions

Two earlier publications (1, 2), one a full-length book complete with illustrations, the other a monograph, detail our findings as to the age changes which occur in children's Mosaic productions. Both of these studies suggest that rather clear-cut age changes do occur in the child's Mosaic products, and that such systematic changes take place in a majority though not in all child subjects studied by us.

2. Rank Order Consistency, within Any Given Group, of Child Mosaic Products Made from Age to Age

If our finding that children as they grow older make increasingly "mature" Mosaic products, then it should be possible to arrange Mosaic products of any given group of children in rank order from "best" to "worst," taking into account chiefly maturity or immaturity of performance with respect to the age in question, but also giving some consideration to accuracy and pleasingness of product.

We have thus arranged all of the present subjects who stayed in school long enough to be available for all four tests in rank order, from best to worst for each separate class group. Thus 61 original kindergarten subjects were considered, in their four separate class groups into which they were divided when we first saw them. (This seemed to us to be a more feasible procedure than ranking all in a single rank ordering.) Twenty original first-grade subjects were so ranked, and 28 original second graders.

Rank order arrangement of these subjects was admittedly somewhat subjective, certainly more so than would be the ordering of responses to a test which could be rated by a single scoring figure. Such decisions as whether a "successful" object was "better" than a "successful" design, or whether an

attractive slab was necessarily "worse" than a design, are most difficult to make, but since one person only made the orderings, at least the same type of judgment was used throughout.

Once such a rank ordering has been made, assuming that there is any useful predictability as to level of performance from one test to the next, presumably the rank order should remain somewhat consistent. The extent to which rank orders of any given class group did remain consistent from test to test was determined by the method of rank order correlation. Results are given in Table 2.

Study of Table 2 shows that there tends to be a substantial though by no means complete consistency of rank order of subjects, in any given group, from one test to another. Among the kindergarten subjects, Groups A and B, which show the greater consistency, were made up of the ablest children, judged on the basis of *IQ* and teachers' estimation of general readiness; Groups C and D, of the less well endowed.

The original first-grade subjects, as they proceeded into second and then third grade, and the original second-grade subjects as they proceeded into third, fourth, and fifth grade, showed considerably greater consistency of rank order than did the original kindergarten subjects. The greatest obstacle to consistency of ranking seemed to be certain individual subjects whose rank order changed markedly with time, in one instance from lowest to highest in the group. This degree of change was of course unusual, but did occur.

Though a developmental study of our own (3) has suggested that there *tends* to be a marked consistency of rating for any one child on any given test on successive examinations, such consistency can by no means always be demonstrated, regardless of the type of test. Thus the Mosaic is by no means unique in not producing perfect consistency of rank order. However the fact that it is the original kindergarten group (5- or 5½-years-old at the time of the first test) which is the least consistent suggests to us that so far as this particular test is concerned, there is greater consistency of rank order as the child grows older. It appears to us (though this is a somewhat subjective observation) that there is a rather large developmental step which must be taken between five and six years of age. Some children appear to be slower, or to have more difficulty than others, in making this step. Thus a child whose product ranked rather high, relatively, within his group at five years of age might not, when his 5½-year-old test was given, have taken this developmental step. Thus his 5½-year-old product might rank lower, relatively, within the group than did his earlier product. Once over this hurdle he might, at a later age, regain his relatively high position within his group.

At any rate, consistency of rank order in our oldest group who were seven, eight, nine, and ten years of age at the time of their four examinations, is extremely high. And even the original first-grade group who were six, seven and eight years of age when examined (there were two examinations given during their sixth year) show quite high consistency.

3. *Relation Between Intelligence and Consistency of Rank Order*

Since among the four kindergarten divisions the two groups considered by the teachers as on the whole the better endowed showed greater consistency than did the two less well-endowed groups, the possibility suggested itself that perhaps better endowed subjects tend to maintain a greater consistency of performance, and thus of rank order within their group, than do those who are less well-endowed. (However, working against this possibility would be the fact that extremely inadequate subjects might be very consistent in remaining at or near the bottom of the group so far as rank order is concerned.)

Checking this possibility, we find that the four kindergarten classes, in descending order of presumed excellence of students (by teachers' evaluations) have the following mean *IQs*: 117, 116, 117 and 104. Mean *IQ* for the first grade (which from test to test showed greater consistency of rank order than did *any* of the kindergarten groups) is 106. These figures give no support to our hypothesis.

Following up this possibility a little farther, we have determined the mean *IQ*, in each group of subjects, for the four most consistent and the four least consistent children. Table 3 shows that in every instance the mean *IQ* of the four most consistent exceeded the mean *IQ* of the four least consistent.

TABLE 3
MEAN *IQs* OF THE FOUR MOST CONSISTENT AND THE FOUR LEAST CONSISTENT
SUBJECTS IN EACH GROUP

	Kinder- garten A	Kinder- garten B	Kinder- garten C	Kinder- garten D	First	Second
Most consistent	129	119	125	112	109	117
Least consistent	114	116	113	97	96	104

These figures give slight support to the possibility that better endowed individuals do tend to behave more consistently, from age to age, in relation to the total group performance than do those who are less well endowed.

4. *Comparison of Rank Order Position and Readiness or Unreadiness for School as Judged on Other Tests*

Assuming that adequacy in response to the Mosaic test for any given age level does, as we consider probable, offer at least one bit of evidence of readiness for school performance at that level, we would expect that a child who was "ready" for any given grade would make a "better" Mosaic product than a child who was "unready." Thus in any given class group, we would expect the "ready" children to have a higher rank order than an "unready" child when products of all children in the group are arranged in order, from best to worst, as was done with these data.

To determine whether or not this was the case, we have divided subjects (original kindergarten, original first grade, original second grade) into three groups: those judged by all three examiners as being consistently ready from year to year; those judged by all three examiners as being questionable; and those judged as unready. Only subjects were considered at this step for whom ratings of the three examiners agreed.

Then we calculated mean and median rank orders for each group separately. Results are given in Table 4, which shows clearly that in every instance except for the second-grade subjects, the means and medians for the "ready" students were lower than for the "questionable" students. That is, the "ready" students in each instance were ranked nearer the top of their group than the questionable and unready students. Furthermore, means and medians for the "questionables" were lower than those for the "not readies." This was true for all kindergarten subjects on each of the four tests; also for the first-grade students.

For second-grade students in each of the four tests which they were given, mean and median rank order for the ready subjects was considerably lower than that for the "not readies," but on the first, third, and fourth tests the median for the "questionables" slightly exceeded that of the "not readies."

These figures thus bear out the expectation that those children in a class who make the better Mosaic products (those rated nearer the top of the group as arranged from best to worst) are more likely to be judged ready for demanded school performance than are those children who make less good Mosais.

This correspondence, however, though it shows up well in the means and medians, is by no means perfect. Thus some subjects who make excellent Mosaic products are judged not ready on the basis of other tests, and vice versa. The extent to which this can be true is suggested by a study of Table 5, which gives the range of rank order of Mosaic products in the

TABLE 4
MEANS AND MEDIANS, RANK ORDER* POSITION OF SUBJECTS CONSISTENTLY READY,
QUESTIONABLE AND NOT READY

	Test 1	Test 2	Test 3	Test 4
Original Kindergarten Groups (55 subjects)				
<i>Ready</i>				
Mean	6.66	6.62	6.17	6.32
Median	6.66	5.00	6.00	5.00
<i>Questionable</i>				
Mean	8.00	7.35	8.05	7.60
Median	7.50	7.00	8.00	8.00
<i>Not Ready</i>				
Mean	10.91	10.66	10.08	10.75
Median	11.00	11.50	11.00	10.00
Original First Grade (20 subjects)				
<i>Ready</i>				
Mean	9.00	8.75	10.00	9.80
Median	8.50	7.50	10.00	10.80
<i>Questionable</i>				
Mean	11.00	10.14	11.00	12.43
Median	10.00	10.00	13.00	15.00
<i>Not Ready</i>				
Mean	16.00	18.00	14.66	15.00
Median	17.00	19.00	18.00	18.00
Original Second Grade (28 subjects)				
<i>Ready</i>				
Mean	12.25	10.87	10.37	13.00
Median	11.00	10.50	9.50	13.00
<i>Questionable</i>				
Mean	18.20	18.00	18.60	17.40
Median	23.00	19.00	22.00	20.00
<i>Not Ready</i>				
Mean	18.60	19.00	20.00	18.75
Median	21.00	21.00	20.00	19.50

* Rank order arranged best to worst.

several groups. This table shows that though in general the ready subjects did have lower rank order (as arranged from best to worst) than the not readies, there was considerable overlap, especially in some groups. Least overlap is evident in the original first-grade group, but as will be seen, in original second-grade subjects, on the first test, one "ready" child rated as high as number 24 out of 28 in the group; whereas one "not ready" rated as low as number 6.

TABLE 5
RANGE OF RANK ORDER IN THE SEVERAL GROUPS

	Test 1	Test 2	Test 3	Test 4
<i>Kindergarten</i> (55 subjects)*				
Ready (By 3 Ex's.)	(1- 9)	(1-11)	(1-10)	(1- 7)
Ready (By 2 Ex's.)	(1-14)	(3-16)	(1-15)	(1-16)
Questionable	(1-16)	(1-16)	(1-16)	(1-15)
Not Ready	(7-14)	(7-13)	(2-13)	(7-14)
<i>First Grade</i> (20 subjects)				
Ready	(1-15)	(3-16)	(4-17)	(4-14)
Questionable	(3-20)	(2-18)	(3-19)	(3-19)
Not Ready	(13-18)	(15-20)	(6-20)	(7-20)
<i>Second Grade**</i> (28 subjects)				
Ready	(3-24)	(1-24)	(1-24)	(1-22)
Questionable	(2-27)	(2-27)	(2-27)	(2-26)
Not Ready	(6-28)	(6-28)	(12-28)	(11-25)

* Numbers in rank order do not go up to 55 as each of the four kindergarten classes was ranked separately.

** Only 26 subjects available for Test 4.

5. *Extent to which Mosaic Response Agrees with Developmental and Visual Examinations in Indicating School Readiness or Unreadiness*

Ideally, if a battery of different kinds of tests is to be given to determine a child's readiness for any given grade, results of the several tests should agree with each other in indicating such readiness or unreadiness. And very frequently they do. If a given child is markedly advanced in one area of behavior, in this instance in his response to the developmental examination, it very often happens that he also shows himself to be advanced in visual behavior and in his response to such a projective test as the Mosaic. A child who is conspicuously retarded on the developmental examination tends to give immature or inadequate responses to the visual and projective tests.

However this is by no means always the case. Development in any given child can proceed unevenly. This is frequently demonstrated in a child's response to the Gesell Developmental Schedule in infancy or in the preschool years (4), where any given child may well be advanced in language and personal-social behavior, but considerably behind the average in motor and adaptive, for example.

Thus from our experience with other tests we would anticipate that there would be a conspicuous degree of correspondence in adequacy or inadequacy of response to the developmental, visual and projective tests (the three kinds

of tests used in the present school readiness battery), but by no means complete correspondence.²

Table 6 indicates the extent to which each group of subjects (original kindergarten, first grade and second grade) agree, on each testing, in their responses to developmental and visual examinations.

TABLE 6
EXTENT TO WHICH MOSAIC RESPONSE AGREES WITH DEVELOPMENTAL AND VISUAL TESTS
IN INDICATING SCHOOL READINESS OR UNREADINESS

	Developmental and Visual agree			Mosaic agrees with other two	
	Total no. of cases	No. agree	% agree	No. agree	% agree
<i>Kindergarten</i>					
Test 1	78	53	68	46	87
Test 2	82	51	62	43	84
Test 3	66	46	69	31	67
Test 4	65	44	68	24	54
<i>First Grade</i>					
Test 1	25	22	88	20	91
Test 2	26	18	69	13	72
Test 3	22	14	64	9	64
Test 4	20	12	60	8	66
<i>Second Grade</i>					
Test 1	31	18	58	14	78
Test 2	29	18	62	13	72
Test 3*	29	20	69	10	50

* Developmental and visual tests were not available for the second graders in their fourth year.

As this table shows, there is agreement in the readiness evaluation made on the basis of the developmental and visual examinations in from 58 per cent to 88 per cent of the subjects in any one group. The greatest degree of agreement occurs in first-grade subjects (six-year-olds) on the first test. The smallest amount of agreement occurs in second-grade subjects (seven-year-olds) on their first test.

Considering only those cases where the developmental and visual evaluation agree, we have determined in what per cent of subjects the Mosaic evaluation agrees with the other two tests. Table 6 shows that this percentage ranges from a low of 50 per cent in original second graders on their third test, to a high of 91 per cent in first graders on their first test. In every group of subjects, the degree of agreement between Mosaic and other

² It is anticipated that after we ourselves have become more experienced in the evaluation of school readiness test responses, and when the Mosaic response in children is understood better, an even greater correspondence will make itself evident.

tests decreases from first to later testing sessions. Why this should be the case is most difficult to explain. Certainly it does seem that we find it more difficult to reach an effective determination of school readiness as the child grows older.

6. *Further Check on Mosaic as Indicating Readiness or Unreadiness*

A slightly different approach to the same data was made by listing all subjects (eight) who were judged consistently ready by all examiners, and all subjects (12) who were judged consistently unready by all.

Then we checked to see how many of the consistently ready subjects were in the top third of their class group as Mosaics were arranged in rank order from best to worst; and how many of the consistently unready subjects were in the bottom third of the group as to rank order. If the Mosaic were completely predictive, presumably all of the consistently ready subjects would fall in the top third of their group; all of the unready subjects would fall in the bottom third.

For the consistently ready subjects, on every one of the four examinations available, 75 per cent of the subjects did fall in the top third of their group. Thus there appears to be a strong relation between school readiness and excellence of Mosaic performance.

For the consistently unready subjects, only 58 per cent fell in the bottom third of the class as to Mosaic performance, on tests 1 and 2, and only 50 per cent on tests 3 and 4. Thus though excellence of Mosaic performance and school readiness seem highly correlated, the same cannot be said for unreadiness and poor Mosaic performance. Few "ready" children make poor Mosaics; but a good Mosaic does not appear to be necessarily a sign of readiness unless supported by good performance on other tests.

7. *Quality of Mosaic Responses Compared with Teachers' Judgments of Readiness or Unreadiness*

One of our chief interests in the present investigation was to determine the extent to which the quality of the child's Mosaic response agreed with the teacher's evaluation of his school performance.

At the end of each school year, teachers were asked to rate each child as ready for promotion to the next grade, questionably ready, or not ready. Ideally, if the Mosaic response is predictive of school performance, all "ready" children would have received a + on their Mosaic, all "questionable" children a \pm , and all "not ready" children a —.

We have chosen for comparison Mosaic products made during the first year

of our experiment with teachers' judgments made at the end of that first year—this because teachers' judgments tend to be more discriminating and incisive the younger the pupil. By the time a child is in the third grade or higher, assuming that he has continued to be promoted even though unready on our tests, a teacher appears to be very slow to give him a flat "unready" evaluation.

Table 7 shows the extent to which evaluations of the Mosaic response agreed with teachers' evaluations. Though correspondence is far from perfect, it will be seen that more often than not children judged ready by the teacher had earned a + on their Mosaic product; those rated questionable had earned a \pm ; those rated not ready, a —.

TABLE 7
FIRST MOSAIC FOR EACH GROUP COMPARED WITH TEACHERS' JUDGMENTS

Teachers' judgment	Mosaic rating			Mean mosaic rank order, best to worst
	+	\pm	—	
Kindergarten Group I				
Ready	10	3	0	8.07
Questionable	0	1	0	7.00
Not ready	0	0	3	12.00
Kindergarten Group II				
Ready	3	7	0	6.80
Questionable	0	4	2	9.33
Not ready	1	1	0	12.00
Kindergarten Group III				
Ready	3	2	2	7.85
Questionable	1	5	0	7.83
Not ready	0	1	4	12.75
Kindergarten Group IV				
Ready	3	4	1	7.62
Questionable	2	2	2	8.17
Not ready	0	0	2	13.00
First Grade				
Ready	7	0	0	7.43
Questionable	5	4	2	11.18
Not ready	1	0	0	18.00
Second Grade				
Ready	8	10	0	15.26
Questionable	4	2	0	10.17
Not ready	1	0	1	24.50
All judged ready by teacher	34	26	5	8.84
All judged questionable by teacher	12	18	6	8.95
All judged unready by teacher	2	2	11	15.37

A second method of comparison figured mean Mosaic rank order scores for all subjects (in each class group) for children judged ready, questionable, and not ready. As Table 7 shows, in most instances Mosaics of "ready" students were clearly distinguishable from those of the "not ready" students. Accurate distinction between "ready" and "questionable" students was difficult to make.

D. DISCUSSION

The Mosaic test, like any projective technique, has a double task. It presumably indicates the developmental level at which a child is performing, while at the same time it gives clues as to personality structure. However, the Lowenfeld Mosaic is still a rather new test and developmental studies dealing with it are still in their infancy. Thus at our present stage of knowledge we cannot always distinguish immaturity from basically meagre endowment. It is hard to say whether the child who makes a poor Mosaic is simply immature, or whether he has an extremely meagre personality endowment which may not "improve" even with added age.

Thus if a six-year-old boy makes a typical four-year-old circle of six large triangles, we cannot always be certain whether he is performing at a four-year-old level now but may later catch up, or whether he is merely showing a limited personality makeup and possibly low intelligence. Obviously, so far as school is concerned, if the poor product is confirmed by other tests as indicating immaturity, revised grade placement and a slower course in school may be indicated. If, however, the poor Mosaic indicates an impoverished personality but not accompanying immaturity, corrected grade placement may not be the solution. (In fact, there may be no "solution.")

Findings of the present study, as indicated above, are that the Mosaic test seems to agree well with other tests in indicating school readiness or unreadiness in five- and six-year-olds. By seven years (second grade) and thereafter, it is somewhat less useful. The reason seems to be as follows:

In the first six years of life, the Mosaic, whatever it may tell about individuality, seems clearly to show developmental status. It is fairly easy for the experienced examiner to distinguish between two-, three-, four-, five-, six-, and in many instances seven-year-old products. This developmental distinction is somewhat harder to make by eight and nine years of age. (Also by eight or nine years and following, the Mosaic seems to tell us fully as much about basic individuality factors as it does about sheer development. Thus by these ages, the examiner is called upon to distinguish as much between different kinds of personality as between different developmental levels.)

Thus so far as five- and six-year-old children are concerned (kindergarten

and first-grade beginners) the Mosaic appears to be quite useful in determining school readiness since it quite clearly can indicate children who are not up to a five- or six-year-old level of performance. Therefore it is useful in ruling out the extreme cases.

By second and third grade (seven and eight years) the extreme cases have usually been ruled out by normal school procedures. And the Mosaic of itself is now revealing as much about individuality as about developmental level. Thus its task is for both these reasons less than earlier, one of determining developmental level, and it is for this reason somewhat less useful as a test of school readiness.

However, even as late as seven and eight years of age, though here we would not wish to depend on the Mosaic alone to determine school readiness, it is still useful in spotting the atypical personality. Thus when other tests suggest questionable readiness, but the diagnosis is not clearcut, the projective tests often show an atypical personality and thus help considerably in clarifying the problem.

E. SUMMARY

The present study aims to determine the extent to which the Lowenfeld Mosaic test is useful in predicting school readiness in children from kindergarten through fifth grade, and the extent to which Mosaic-test results correlate with findings from developmental and visual tests, and with teachers' evaluations of readiness.

Subjects were 81 kindergarten children, most of whom were later available in the first and second grades, 28 first graders tested subsequently in second and third grades, and 31 second graders tested subsequently in third, fourth, and fifth grades. These children were students in a public primary school in Connecticut, the majority being of high average or superior intelligence and coming from professional or semiprofessional families.

Earlier publications have attempted to show that clearcut and to some extent predictable age changes do occur in the child's Mosaic product. These stages have been defined elsewhere (1, 2). Knowledge of these age changes, and of more or less what to expect at any given age, permitted us to arrange the products of each of our three groups of subjects in rank order, from best to worst. Rank order from test to test, that is from year to year, was shown to be relatively consistent for all three groups of subjects. We also found some support to the hypothesis that better endowed individuals do in general tend to behave more consistently, from age to age, in relation to the total group performance than do those who are less well endowed.

Then a check was made to see whether or not the Mosaic test was useful in determining school readiness, and whether results on the Mosaic agreed with those in other types of tests. Subjects were divided, each grade separately, into three groups—those judged by all examiners as being consistently ready from year to year; those who were questionably ready; and those who were unready. Mean and median Mosaic rank order was calculated, for each class, for the ready, questionable, and unready groups. Almost without exception, the means and medians for the “ready” students were lower (i.e., showing a better rating) than those for the “questionable” students; and means and medians for the “questionable” students were lower than those for the unready students. That is, subjects whose rank order showed them to be among the best in their group for their Mosaic product, were more likely to be ready as judged by other tests, than those near the bottom of their group in rank order. However, in spite of this there was a rather wide range of rank order in every group. Thus some “ready” children did make a poor Mosaic; some “unready” children, a good one.

A specific comparison of Mosaic results with those of developmental and visual examinations shows that among the three groups of subjects and on the several annual tests, in those instances where the developmental and visual examinations themselves agreed, the Mosaic agreed with these other two tests in from 50 per cent to 91 per cent of the subjects in any one group. The greatest degree of agreement occurs in the first grade (six-year-old subjects) and in kindergarten subjects (five-year-olds) on their first tests. Agreement becomes less good as subjects grow older.

Though correspondence between excellence of Mosaic product and teachers' evaluations of school readiness was far from perfect, it was found that more often than not children judged ready by the teacher had earned a + on their Mosaic product; those rated questionable had earned a \pm ; those rated not ready, a —. Our subjective impression was that teachers' judgments as to readiness or unreadiness were more incisive and discriminating, the younger the pupil. By the time a child is in third grade or higher, assuming that he has continued to be promoted even though unready on our tests, a teacher appears to be very slow to give him a flat “unready” evaluation.

Present findings suggested that the Mosaic test is most useful in predicting school readiness, or at least in supplementing other tests in arriving at such a prediction, at five and six years of age, at which ages any readiness test can be most useful, practically, so far as determining school placement is concerned.

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CONCEPT FORMATION AND THE DEVELOPMENT OF ETHNIC AWARENESS^{*1}

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A. INTRODUCTION

The term "concept" has been defined by Heidebreder as "a logical construct which, by means of symbols or signs, may be used interpersonally" (4, p. 3), and "concept formation" by Kendler as "the acquisition or utilization, or both, of a common response to dissimilar stimuli" (7, p. 447). Considered in this light, it follows that a concept provides for the organism one tool whereby some degree of mastery over the environment can be achieved; and the attainment of a concept is congruent with the extent to which the organism has differentiated and structured its environment.

How do concepts originate? Logically, it could be argued that, before a common response to dissimilar stimuli can be achieved, the organism must first be able to discriminate between the stimuli in question. In discussing this point, Bruner, Goodnow, and Austin wrote:

to categorize is to render discriminably different things equivalent, to group the objects and events and people around us into classes, and to respond to them in terms of their class membership rather than their uniqueness (1, p. 1).

Learning to categorize, the authors continue, provides a principal means by which socialization proceeds, and concept attainment reflects, to some extent, the demands of one's culture.

A complication arises when a "discriminations-leading-to-categorization" analysis, as outlined above, is applied to the problem of the development of ethnic awareness in young children. For, in this instance, the child is discriminating between, and eventually categorizing, people rather than things. A distinction is drawn here between thing-objects and person-objects. Where the latter are involved, the organism is faced with a situation in which it has attributes in common with one or more discriminable stimuli. Using an

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oddity problem to illustrate: suppose that a young white *S* is asked to choose the odd one from among one white and two colored people. A failure of *S* to make the correct choice could be interpreted in two ways: (a) he is incapable of discriminating between the colors involved (which is unlikely); or (b) the color discrimination is not considered by *S* to be a factor of importance, and the stimuli are rendered equivalent in that they are all people. At any rate, in concluding on this evidence that *S* is completely incapable of discriminating ethnic differences, one could be turning a blind eye to certain restrictions imposed by the oddity task method. At this point, an alternative theoretical proposition is offered: according to the extent of differentiation between self and environment, it is conceivable that a young *S* will revert to a primitive discriminative mechanism of "identification" where other means of discrimination are ineffective.

In treating the problem of identification, Freud (2, 3) referred to an undifferentiated perception of an external object and the self in the initial states of development (primary identification), which gives way in later development to a discrimination of a world of objects separate from the self, including some with which the organism may identify (secondary identification). More recently, Kagan (6) analyzed the term identification within a learning theory framework, proposing that the main goal states of identification are: (a) mastery of the environment; and (b) love and affection, in contradistinction to Freud's view that identification provides a means for reducing anxiety arising from oedipal conflict. For the purposes of the present report, attention is directed to Kagan's proposition that mastery of the environment can be associated with the process of identification. The implication for a study of ethnic awareness is that it should be possible to organize within the one schema the processes of identification, self-differentiation, discrimination, and concept attainment.

B. PROBLEM

In view of the points considered above, it would be reasonable to predict that ethnic awareness will depend initially upon the perception of discriminably different objects. However, since a concept of race is derived from categorizing attributes of person-objects rather than thing-objects, it is likely that an identification process may also be involved. In the present study, it was hypothesized that the ontogenetic appearance of the phenomena relating to the formation of an ethnic concept would be as follows:

1. Identification by race with person-objects.
2. Discrimination by race between person-objects.
3. Attainment of a concept of race.

The problem of distinguishing between these three proposed "levels of awareness" was felt to be largely a methodological one. In this respect, Johnson's (5) discussion of the traditional methods for investigating concept formation provides a useful theoretical setting. Two basic methods are outlined: (a) free-response; and (b) objective discrimination methods. Usually, the former is more appropriate for testing the personal meaning of a concept, and the latter for the standardized (cultural) meaning. It has also been found that these methods differ with respect to the criteria of task mastery involved, in that some Ss can pass some tests but not others. Johnson concludes that "as in any other area of science, the results are determined in part by the method, and the best results come from a convergence of two or more methods" (5, p. 233).

The construction of a test continuum based on task difficulty, incorporating both free-response and objective discrimination methods, was considered to be a worthwhile approach to testing the adequacy of the three awareness levels proposed in this study. An awareness level is here defined as "task mastery at a specified point on the test continuum." The nature of the test continuum constructed for this research is discussed more fully following the description of the test material.

C. METHOD

1. *Subjects*

The Ss were 180 White children enrolled in four nursery and primary schools in Wellington, New Zealand, a city with a population of 237,000 Whites and 3,500 Maoris in the year 1960. The children ranged in chronological age (CA) from four through 12 years, 20 Ss being assigned to each of nine CA groups at successive one-year intervals. The group means by age (years and months) were as follows: 4.0, 5.4, 6.0, 7.1, 8.1, 9.0, 10.2, 11.0, and 12.1. All groups were divided evenly according to sex. A few Maoris attended each of the nurseries and schools, so that some play contact between the two races was possible. The Ss were selected at random from class rolls.

2. *Materials*

Seven tests employing doll and picture materials were constructed for this study. The purpose of the tests was to investigate stages in the development of the concept "Maori." The tests were as follows: Picture Identification, Doll Identification, Picture Discrimination, Doll Discrimination, Doll Assembly, Doll Classification (part A), and Doll Classification (part B). The picture materials were constructed from a set used in a previous study (10).

a. Picture identification. Six picture sketches showing three Whites and three Maoris, all of the same sex as *S*, were arranged in random fashion before *S* who was asked "which child looks most like you?" A response was recorded in terms of whether a White or Maori figure was chosen.

b. Doll identification. Two two-dimensional hardboard dolls seven inches high of the same sex as *S* were used. One doll was painted to represent a White and the other a Maori. Each *S* was shown the dolls and asked "which doll looks most like you?" A response was recorded in terms of whether a White or Maori doll was chosen.

c. Picture discrimination. Similar in design to a test used by Stevenson and Stewart (9), this test consisted of 18 six \times four inch pictures, 12 (6M, 6F) of which were related to race while the remaining six were employed as fillers. Each *S* received the fillers, followed by six race cards depicting figures of the same sex as *S*. The pictures were presented to *S* in four sets, three pictures at a time. The two filler sets (showing two aeroplanes and a yacht, two apples and a banana) were shown in turn to the *S*, who was asked to indicate the picture that differed from the other two. At this stage, a correctional procedure was adopted when *S* made an incorrect response. Following this, the two race sets (showing one White and two Maoris, two Whites and one Maori, all of same sex as *S*), were presented together with the same instruction, but without corrections being offered by *E*. A response was recorded as correct if the figure differing by race was chosen. All sets were presented so that the correct choice varied through three horizontal positions: left, middle, and right.

d. Doll discrimination. Three female dolls 12 inches high, made of a flesh-colored vinyl, were used. The dolls were dressed in green frocks, white bonnets, white boots, and were identical in appearance except that two had pink skin and blue eyes (White dolls), while the other had brown skin and brown eyes (Maori doll). A response was recorded as correct if the Maori doll was chosen as being different.

e. Doll assembly. Two two-dimensional dolls seven inches high, of the same sex as *S*, were used. Each doll consisted of six pieces: a head, a torso, two arms, and two legs. One set of pieces was painted pink, and the other brown. The *S*'s task was to assemble the 12 pieces, presented in random array, so as to make two dolls. A response was recorded as all-correct if *S* assembled the dolls without mixing the pieces by color.

f. Doll classification (part A). A brown-skinned doll similar in make to those dolls used in the Doll Discrimination Test was used. This doll, however, was dressed in traditional Maori costume: a grass skirt, a

feathered cape, a *tiki*², and a headband. *S* was asked "what sort of doll is this?" A response was recorded as correct if the word "Maori" was used.

g. Doll classification (part B). At the conclusion of the Doll Discrimination Test, and prior to part A of the Doll Classification Test, *E* pointed to the brown-skinned doll dressed in a White's clothing and casually enquired of *S* "what sort of doll is this?" As in part A above, a response was recorded as correct if the word "Maori" was used.

3. Relation between Materials and Test Continuum

The seven tests used are discussed below in relation to the three proposed awareness levels.

a. Identification tests. Tests 1 and 2 require *S* to identify by physical appearance with a picture and a doll. Since the tests are structured, and as *S*'s response can be nonverbal, they could be placed in the Objective Method category. The main psychological factor presumed to be operating is identification, associated with a low-level discrimination (differentiation of self from the dissimilar figure). These tests, then, were designed to measure low awareness.

b. Discrimination tests. Tests 3 and 4 consist of two oddity tasks using picture and doll materials. Once again, these tests are included in the Objective Method category for the same reasons noted above. The discriminative process in this case, however, requires something more than identification on the part of *S*—i.e., the tests were designed to measure medium awareness.

c. Assembly test. The test instruction "make up two dolls out of these pieces" implies "put those things together that belong together." The task, therefore, requires *S* to categorize as well as to discriminate. Johnson (5) has referred to a test of this kind as a limited free-response method. In terms of the test continuum used in the present study, the Doll Assembly Test was designed to provide a task whose difficulty was intermediate between the Discrimination Tests and the Classification Tests. Since a verbal response is not essential to mastery, success *per se* in this test does not indicate concept attainment. Its purpose, therefore, was to measure the upper limit of medium awareness.

d. Classification tests. Both of these tests employ the instruction "what sort of a doll is this?", and could be included in the Free Response category. *S*'s task is now verbal, and the accuracy of his description provides a measure of not only task mastery, but also mastery of the concept "Maori." When the

² A traditional Maori amulet.

brown-skinned doll was dressed in traditional Maori costume (part A), it was assumed that cues pointing to the correct verbal response were maximal, while the substitution of a White's clothing (part B) was a restriction upon the cues available. These two tests, then, in the order given above, were designed to approach the end point in the envisaged test continuum, and served to measure concept attainment or *high* awareness.

4. Procedure

The general order of presentation was to show *S* the picture material initially, then the two-dimensional dolls, and finally the three-dimensional dolls. The tests were imbedded within a larger battery relating to ethnic attitudes, the results of which will be reported at a future date. *Ss* were tested individually at school. Testing time per *S* averaged about 15 minutes.

D. RESULTS

The focus of attention in this study was directed towards a comparison between a number of age groups in terms of correct responses to seven ethnic awareness tests. The proportion of *Ss* at each CA from four through 12, making correct responses on each of the seven tests, is shown in Table 1. An indication is given in the table where statistical tests are not applicable (*n.a.*).

A preliminary analysis of the data shown in Table 1 revealed that the general tendency for all *Ss* ($N = 180$) was to make significantly more correct than incorrect responses to each of the seven tests. The means of the proportions for the tests ranged between .61 and .92, and the attached CR values satisfied a test of significance at the .01 level. The proportion of correct responses was found to be positively correlated with age ($p < .01$) for Tests 3, 5, 6, and 7. Correlations based on CA group rankings were not applicable for Tests 1, 2, and 4, in that the tendency for correct responses to increase with age levelled off at early CA levels. However, the overall trend was the same: for each test, the proportion of correct responses increased with age until a stable level of performance was reached.

A secondary analysis of these data was carried out to determine the earliest CA for each test at which a significant proportion of *Ss* made correct responses. The results of this analysis are incorporated in Table 1 in the form of asterisks indicating the earliest age at which mastery of each task was achieved. An inspection of these results reveals a general tendency for Identification Tests to be mastered before Discrimination Tests, and for the latter to be mastered before Classification Tests, in terms of age. This

TABLE 1
PROPORTION OF 20 CHILDREN AT EACH OF 9 AGE LEVELS MAKING CORRECT RESPONSES ON
7 AWARENESS TESTS

Test ^a	Age Level									Mean	CR	Rho
	4	5	6	7	8	9	10	11	12			
1. Picture identification	.75*	.80	1.00	1.00	.90	1.00	.90	.95	.95	.92	11.80	n.a.
2. Doll identification	.60	.85*	.85	.80	.80	.95	.90	.90	.80	.83	8.80	n.a.
3. Picture discrimination	.53	.55	.68 ^b *	.70	.70	.70	.73	.83	.73	.68 ^c	n.a.	.954
4. Doll discrimination	.70	.75*	.95	1.00	.95	.95	.95	.95	.95	.91	10.73	n.a.
5. Doll assembly	.20	.55	.60	.85*	1.00	1.00	1.00	1.00	1.00	.79	7.90	1.00
6. Doll classification (A)	.55	.60	.55	.80*	1.00	1.00	.95	1.00	1.00	.82	8.64	.925
7. Doll classification (B)	.35	.30	.40	.65	.70	.70	.75*	.80	.80	.61	2.83	.975

^a The data at each CA for Tests 1, 2, 4, 5, 6, and 7 were tested for significance by the Sign Test, and that for Test 3 by the Chi-square Test. Both Tests 3 and 4 were oddity tasks involving three objects at a time, the probability of a correct choice being 1/3. However, since this study is concerned with the extent to which each CA group has *mastered* each task, the data for Tests 3 and 4 were tested for significance against a chance probability of 1/2 rather than 1/3.

^b Based on data derived from two sets of three pictures ($\chi^2 = 6.10$, $df = 2$, $p < .05$).

^c $\chi^2 = 47.69$, $df = 2$, $p < .001$.

* Significant at the .05 level.

tendency, in relation to three proposed levels of concept formation, is depicted in Figure 1. As it was not clear before testing whether task difficulty was related to the nature of the materials used (in the present case, dolls and pictures), the ordering of Test 1 in relation to 2, and of 3 in relation to 4, along the y-axis is a *post hoc* one which maximizes the predicted trend.

No consistent or significant sex differences were found in any aspect of the present research.

E. DISCUSSION

The discussion of results presented below is restricted to the secondary analysis of the relation between CA and task mastery on each of the seven tests, and the implication of this analysis for the treatment of the development of ethnic awareness within a concept-formation framework.

In general, the research hypothesis was supported. The simplest tests (Tests 1 and 2), tapping a low-level form of ethnic awareness, involved identification.

The instruction "show me the one like you" is one that has clear meaning for four-year-old Ss who mastered one of the two tests. The concept of self would appear to be operative in young Ss to the extent that they are capable of nominating their membership to a group similar in race to themselves.

The Discrimination Tests, based on oddity problems (Tests 3 and 4), presented tasks which were somewhat more difficult. One was mastered at CA five, and both at CA six. Mastery at this point indicates that S has progressed beyond identifying with his ethnic group to the extent that he can distinguish between other members of the in-group on one hand, and members of an out-group on the other. This mastery has been defined above as medium awareness.³

Mastery of the Doll Assembly Test was achieved at CA seven, one year later than the CA related to the Discrimination Tests, indicating that, in terms of awareness levels, the test does fall at the predicted point on the test continuum—intermediate between the Discrimination and Classification Tests. Because the verbal response "Maori" is not essential to mastery, however, this test is appropriately located at a point between medium and high awareness.

Mastery of the Doll Classification Test (part A) was also achieved at

³ An anomaly in the results relating to Identification Tests was that task mastery was achieved at an earlier CA when picture rather than doll material is considered. The results for the Discrimination Tests, however, provide a reversed trend. One possible explanation is that, while color is a more immediate cue in an oddity problem than is a combination of facial features and achromatic shading, the subtler nature of the latter cues assumes importance in a task involving self-identification.

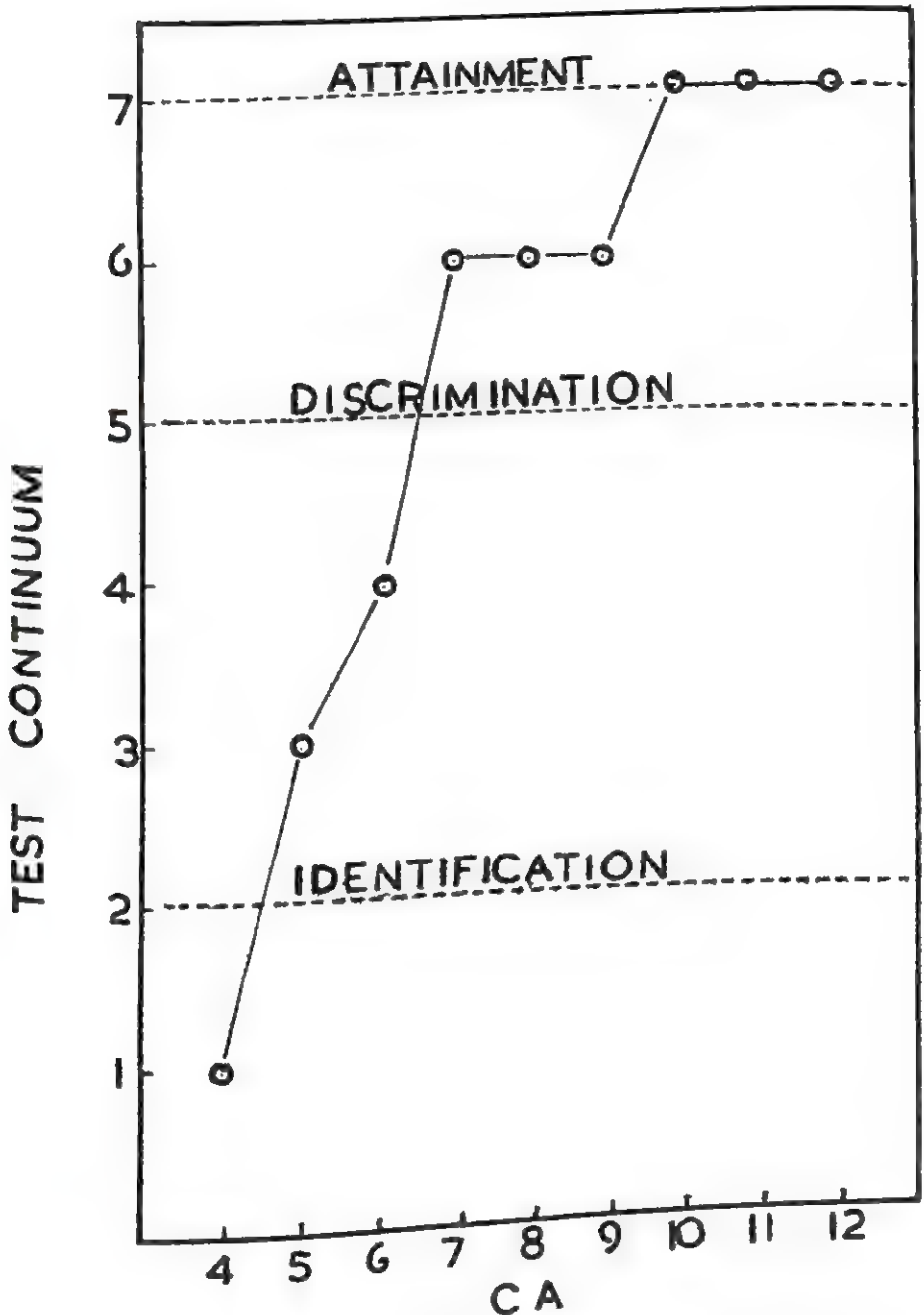


FIGURE 1
DEVELOPMENT OF TASK MASTERY ON A TEST CONTINUUM THROUGH THREE LEVELS OF
ETHNIC AWARENESS
Points on the Test Continuum are as follows: 1. Picture Identification, 2. Doll
Identification, 3. Doll Discrimination, 4. Picture Discrimination, 5. Doll Assembly, 6.
Doll Classification (Part A), 7. Doll Classification (Part B).

CA seven, indicating that this age represents a transitional point at which the degree of ethnic awareness is associated with a somewhat restricted concept of race. Using the present battery of tests, no improvement in task mastery was noted at CA eight or nine, indicating that the concept "Maori" is limited in meaning to figures clothed in traditional Maori costume. It is not until CA 10 that full mastery of both parts A and B of this test is achieved. At this age, *Ss* were successful in mastering all tests offered, and were not dependent on the cue of traditional costume to make the verbal response "Maori." On the present test continuum, no further improvement was allowed for, so that it appeared that a well-developed concept of race had been attained at 10 years of age. It is possible that the use of a more refined test continuum, e.g., one including a Picture Classification Test, might eliminate the plateaux in awareness development noted at CA seven-nine and CA 10-12.

It was concluded that the attainment of a concept of race is dependent upon a capacity to render discriminably different stimuli equivalent. Since the concept involves person-objects rather than thing-objects, however, an identification response precedes ontogenetically the more usual discrimination response.

A final point is worth noting. The problem of the development of ethnic awareness has been here treated within a concept-formation framework. If an affective component is incorporated within this treatment, the scope of theory can be extended to the problem of attitude development. Rhine (8) has already contemplated this possibility.

F. SUMMARY

In this study, the nature of the development of ethnic awareness is examined within a framework of concept formation. The view that a capacity to render discriminably different stimuli equivalent is a prerequisite to concept attainment, is probably sufficient where concrete objects are involved. It was hypothesized that in the case of the development of ethnic awareness, however, the discriminative process underlying the attainment of a concept of race includes a process of identification on *S's* part with one or more of the perceived objects. Seven tests of ethnic awareness, designed to measure low-level (Identification Tests), medium-level (Discrimination Tests), and high-level awareness (Classification Tests), were administered to 180 *Ss* in the age range four-12 years. The research hypothesis was supported, and it was concluded that where the concept of race is involved, an identification response precedes ontogenetically the more usual discrimination response. By

incorporating an affective component, the theoretical scope of the treatment of awareness development within a concept-formation framework can be extended to the problem of attitude development.

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AGE OF LEARNING, SEVERITY OF NEGATIVE REINFORCEMENT, AND RETENTION OF LEARNED RESPONSES*¹

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A. INTRODUCTION AND PURPOSE

Many contemporary psychologists place great stress upon infancy as a period in which are established basic psychological structures which determine the organism's mature responses to a broad range of stimuli. In particular, the determining effects upon mature behavior of infantile *traumatic* experiences have been discussed at some length by psychologists with clinical interests.

But the effects of experiences that occur during infancy can seldom be studied in humans independently of other factors that are known to affect learning and retention. Thus, traumatic experiences may affect subsequent behavior simply because responses learned under intense punishment persist whatever the age at which the learning occurs, rather than because of the particular effects of trauma at certain critical stages of development. The present study was designed to explore the effects of age of learning and of intensity of punishment upon the learning and retention of responses in the albino rat.

B. METHOD

1. *Subjects*

A total of 77 albino rats served as subjects in the experiment; 39 Ss were 90 days old when training began, while the remaining 38 Ss were exposed to training at 21 days of age, about five days after their eyes had opened and coincident with weaning. All Ss were experimentally naive at the beginning of training.

2. *Apparatus*

Subjects were trained to escape from a brightly-lighted single-unit T-maze. The floor of the maze was four inches wide with walls six inches high. The stem and head of the T were 18 and 24 inches long, respectively. At either

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¹ This study was financed by a grant from the Faculty Research Fund of the School of Arts and Sciences, Kansas State College. We are indebted to Dr. Lincoln F. Hanson for information on the threshold of brightness aversion among rats.

end of the head of the T were goal boxes 15 inches long which could be isolated from the T proper by sliding doors which were operated by *E*. The walls and floor of the maze were painted white, and sheets of opal glass covered the maze throughout.

Approximately six inches above the opal glass, and spaced at intervals of eight inches, were ten 500-watt reflector flood lamps. These lamps were connected in series to a Variac by means of which the intensity of illumination in the maze was controlled. Brightness in the goal boxes was fixed at 150 foot candles for the "low intensity punishment" condition (19 of the 21-day-old *Ss* and 19 of the 90-day-old *Ss*) and at 300 foot candles for the "high intensity punishment" condition (19 of the 21-day-old *Ss* and 20 of the 90-day-old *Ss*). The illumination throughout the maze approximated 150 and 300 foot candles for the low and high intensity conditions, respectively, even though a constant brightness level in all parts of the maze could not be achieved. Data provided by Hanson (6) indicate that both intensity levels are sufficient to establish avoidance conditioning in rats, and that the "high" intensity level is considerably more noxious than is the "low."

3. *Experimental Procedure*

On each of the two days just before training began, each *S* was handled for approximately 10 minutes. He was then placed in the stem of the maze with both ends of the "T" blocked off and with the illumination set at the intensity to which he was to be exposed in the experiment proper. The lights were then turned off each time *S* moved to the half of the stem farthest from the starting box and were turned on when he returned to the half of the stem nearest the starting box. This preliminary training lasted for fifteen minutes each day.

In the experiment proper the lamps were first set for the proper intensity of illumination, and *S* was placed in the starting box. Holes drilled at intervals in the walls permitted *E* to see in which direction the animal turned and to determine when it had entered the goal box. A noncorrection procedure was followed; as soon as the *S* was in the goal box, *E* closed the door to prevent his escape. Half of the *Ss* in each experimental group were rewarded for going to the goal box on the right, half for going to the left. Correct trials were reinforced by turning off the flood lamps as the goal box was entered and leaving the *S* for 20 seconds in the dimly-lighted goal box before transferring him to an unlighted (approximately one foot-candle) detention cage. After incorrect trials, *Ss* were forced to remain for 20 seconds in the brightly-lighted goal box and were then transferred to a detention

cage with a clear-glass cover having an illumination intensity of about 20 foot candles.

Each *S* received 10 trials at each daily session; an interval of at least 10 minutes separated consecutive trials for any one *S*. After each session *S* was kept in the detention cage for at least 20 minutes before being returned to his living cage.

Training was continued to a criterion of 18 correct trials in a sequence of 20. Three *Ss*, all 21 days old when training began, failed to meet this criterion within 200 trials and were eliminated from the experiment. A few *Ss* refused to leave the starting box on the first few trials; they were inserted at the head of the "T" for a few trials until they moved readily toward one goal box or the other. To nullify the possible effects of position habits, *Ss* which turned in one direction or the other on all or all but one of the first ten trials were forced to turn in the other direction three times between trials 11 and 16.

Retention trials were initiated 60 days after the training trials were begun. The procedure was identical with that of the training series except that the criterion of retention was a run of correct responses which exceeded chance at the .05 level of significance (5).²

C. RESULTS

1. *Age, Intensity, and Initial Learning*

As may be seen in Table 1, there was no apparent effect of either the age at which training was initiated or the intensity of illumination upon the number of trials required for the animal to reach the criterion of initial learning. Although there was some tendency for the younger animals to learn more rapidly than the older, the difference between the two groups was not statistically significant.

2. *Age, Intensity, and Retention*

We have pointed out previously that our criterion of retention was the number of trials required in relearning the original material before the animal showed a preponderance of successes over failures that differed from chance at the .05 level of significance. Grant's table of such probabilities (5) shows that the fewest number of trials required for a significant deviation from chance is five trials correct out of six. Therefore, animals which achieved the criterion of retention in six or fewer trials, will be referred to as showing

² This change in criterion from learning to retention trials was necessitated by pressure to complete the experiment within a fixed time limit.

TABLE 1
RELATIONSHIP BETWEEN AGE, INTENSITY OF REINFORCEMENT, AND MEAN NUMBER OF TRIALS TO CRITERION OF LEARNING

Group	N	Mean	SD
High Intensity 90 days	19	62.26	34.56
High Intensity 21 days	19	54.37	35.68
Low Intensity 90 days	20	64.57	36.05
Low Intensity 21 days	19	49.47	23.59

TABLE 1A
ANALYSIS OF VARIANCE^a FOR TABLE 1

Source	df	ss	ms	F
Among groups	3	149.31		
Age	1	134.21	134.21	2.39, $p > .05$
Intensity	1	1.45	1.45	—
Age \times Intensity	1	13.65	13.65	—
Error	73	4106.25	56.25	
Total	76	4255.56		

^a The procedure for analysis of variance with groups of unequal size was taken from Snedecor (10).

"Perfect retention." The retention data were markedly skewed; while 40 of the 77 animals exhibited perfect retention by our criterion, a few required an extremely large number of trials (the maximum being 178) before exhibiting retention at less than chance probability. In view of this skewedness, we shall present our results in two ways: first, by means of a contingency table which reveals differences between groups in the proportion of animals showing perfect retention, and, second, in the usual comparison of the mean number of trials required for each experimental group to achieve the criterion.

The performance of the four groups relative to the dichotomy "perfect retention *vs* less than perfect retention" is shown in Table 2. This table provides a chi-square value that is highly significant. By far the largest portion of this chi-square is contributed by differences between the two groups whose training began at 21 days of age. Thus, although for both age groups the high-intensity groups had a higher proportion of animals who exhibited perfect retention, this relationship is especially striking in the younger age group. This result suggests that differences in intensity of reinforcement during the original learning situation affected subsequent retention differentially, depending upon the age at which that initial learning occurred.

TABLE 2
COMPARISON OF NUMBER OF ANIMALS EXHIBITING "PERFECT RETENTION" IN THE FOUR EXPERIMENTAL GROUPS

	90 days old at beginning of training		21 days old at beginning of training		Total
	High Int.	Low Int.	High Int.	Low Int.	
Perfect retention (achieved criterion within 6 trials)	12	9	15	4	40
Less than perfect retention (eight or more trials to criterion)	7	11	4	15	37
Total	19	20	19	19	77

Note: $\chi^2 = 14.15$, $p < .01$.

However, a comparison of the mean number of trials required by animals in the four groups to reach the criterion of retention does not support the hypothesis of an interaction of the effects of age and intensity upon subsequent relearning (Table 3). Since there was a marked correlation between the means and the standard deviations of the groups in the retention trials, a logarithmic transformation was applied to the data before they were analyzed.

TABLE 3
RELATIONSHIP BETWEEN AGE, INTENSITY OF REINFORCEMENT, AND MEAN NUMBER OF TRIALS TO THE CRITERION OF RETENTION

Group	N	Mean ^a	SD ^a	Mean ^b	SD ^b
High Intensity 90 days	19	7.32	4.64	6.57	1.53
High Intensity 21 days	19	7.47	5.64	5.64	1.62
Low Intensity 90 days	20	32.10	47.67	14.65	3.38
Low Intensity 21 days	19	26.25	29.59	17.14	2.62

^a Computed from the data prior to transformation.

^b Antilogarithm of the means and standard deviations of transformed scores.

TABLE 3A
ANALYSIS OF VARIANCE, TRANSFORMED SCORES, FOR TABLE 3

Source	df	ss	ms	F
Among groups	3	.1519	.0506	21.37, $p < .001$
Age	1	.0009	.0009	
Intensity	1	.1496	.1496	
Age \times Intensity	1	.0013	.0013	
Error	73	.5123	.0070	
Total	76	.6642		

As may be seen in Table 3, analysis of variance of the transformed scores shows a significant effect upon retention of intensity of reinforcement, but no effects of age and no interaction between age and intensity.

D. DISCUSSION

1. *The Effects of Age upon Rate of Learning*

The fact that age of initial learning did not affect the rate of initial learning was unexpected. Several experiments (*cf* 2, 9) have shown the superiority of young rats over older ones in such learning tasks.

However, the Denenberg and Kline study (2) provides a plausible rationale for our results. The authors found that rats trained at 60 days of age learned a simple conditioning problem more rapidly than those trained at 30 days, and that both of the younger groups learned more rapidly than did a group trained at 225 days. If the Denenberg and Kline results reflect a true curvilinear relationship between age and rate of learning in rats, then it seems plausible that our groups—in which training began at 21 and 90 days respectively—were drawn from populations whose mean learning rates were equal, but that the two groups were on different sides of the optimal learning age for this task. If this were true, the learning rate would be expected to increase for the younger groups as their age increased, while the learning rate for the older group would have slowed down with age. It may also be true, of course, either that our results reflect a Type II error and that a larger sample would have enabled us to reject the null hypothesis, or that there are no real effects of age upon learning in this situation among rats.

2. *Age of Learning and Retention*

The absence of a main effect of age of learning upon retention in rats parallels the results of several previous studies but contradicts others.

On the one hand, Baron, Brookshire, and Littman (1) found that rats who had been subjected to traumatizing shocks learned a shock-avoiding response more rapidly than did a control group, but that the age at which the trauma was experienced was not related to speed of subsequent relearning. Similarly, Gertz (4) reports that handling rats during infancy does not affect later emotional, exploratory, and learning behavior more than does handling at maturity.

On the other hand, the experiments reported by Forgays and Forgays (3), Hebb (7), Hymovitch (8) and others of Hebb's associates, which we shall refer to as the McGill experiments, show dramatic effects of infantile experience upon subsequent learning ability.

Unfortunately, a comparison of our results with those of the McGill studies is next to impossible, for the experimental procedures differed along so many dimensions that there appears to be no way of examining separately the different factors or sets of factors so as to account for the different results. Thus, the treatment that an animal receives in a T-maze or a shock-avoiding apparatus probably provides him with a much more restricted set of perceptual experiences than were available to the animals studied in the McGill laboratories. Hence, (a) "breadth of experience," however this vague concept is interpreted, may account for the differences in results. In addition, in the avoidance-learning studies, animals were subjected to intermittent training sessions, not to continuous reinforcement as in the McGill studies. Therefore, (b) the differing effects may have resulted from differences in the total amount of training available to the animals; i.e., extensive over-learning may be differentially effective at different ages while learning to a less rigid criterion is not. Furthermore, even Hebb's house-raised rats did not perform better than cage-raised rats in learning to negotiate simple T-mazes; perhaps, then, (c) the retention tests in the avoidance learning studies were restricted to such narrow samples of behavior that real effects of age of learning upon subsequent performance went undetected. Again, the McGill experiments do not include experimental groups which were exposed to the enriched perceptual environment for an extensive period of time, but whose exposure began at maturity. Consequently, (d) the effects of extensive perceptual experiences which these studies demonstrate might be much the same whatever the age at which the animal's experience in the enriched environment begins.

In any event, it seems clear that the hypothesis which connects age of learning unequivocally to retention of the learned response is contradicted by the present results as well as by several previous experiments. If traumatic infantile experiences in the rat do sometimes affect subsequent behavior more than do experiences in the same situation at a later age, the critical condition under which this phenomenon occurs remains to be identified by further investigations.

E. SUMMARY

Four groups of albino rats, two groups of infants and two just past sexual maturity, were trained to escape from a lighted, single-unit T-maze. One group at each age level was subjected to intense illumination while in the maze, the other was subjected to a lower level of illumination. Sixty days after the learning trials had been completed, the same animals were retrained at the original intensity level to determine the degree of retention of learning.

There were no clear effects upon initial learning of either the age at which training was initiated or the intensity of reinforcement. The retention trials showed a significant effect upon retention of intensity, but not of age. The data contain evidence of possible interaction effects between age and intensity.

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AROUSAL AND EXPRESSIVE MOVEMENTS*

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A. INTRODUCTION

The purpose of this paper is first to put forward the hypothesis that the concept of arousal as formulated by Lindsley (7), Malmö (8) and others corresponds to Eysenck's (2) and his associates' construct of psychoticism. Our hypothesis is that these two groups of researchers, the one working from neurophysiology and the other from personality theory, have arrived at similar conclusions and the two fields should benefit mutually from integration. The second purpose of this paper is to present the results of two experiments on expressive movements designed to test this hypothesis.

An attempt will be made to cite briefly, but not in detail, the evidence in favour of our hypothesis that arousal corresponds to psychoticism. Eysenck's construct of psychoticism is made up of three principal types of measure, namely tests of speed of reaction, perceptual efficiency, and expressive movements. It has been shown in a number of investigations that these measures differentiate psychotics (schizophrenics and depressives) from normals, and that they intercorrelate positively in normal and psychotic samples (2, 4, 10). The construct therefore obeys two of the most important criteria of construct validity suggested by Cronbach and Meehl (1). The present argument is that high arousal corresponds to low psychoticism. If this is so, it follows that increases of arousal should have the effect of lowering subjects' scores on psychoticism, i.e., should reduce reaction times, increase perceptual efficiency, and reduce expressive movements. As far as the speed of reaction and perceptual efficiency measures are concerned, there is fairly extensive evidence that both are improved by increases and lowered by decreases in arousal (e.g. 7, 11). There appears, however, to be no evidence on the effects of variations in arousal on expressive movements, and since expressive movements are an integral part of the psychoticism construct, evidence on the variables affecting expressive movements are important for the interpretation of psychoticism. Since high psychoticism is associated with large expressive movements, the present hypothesis yields the prediction that increases of arousal should have the effect of reducing expressive movements. Two experiments testing this hypothesis are reported below.

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B. METHOD

Eysenck (2) has used two principal measures of expressive movement, namely the dimensions of writing numbers and drawing three squares. Both of these measures were used in the present experiments.

1. *The First Experiment*

This experiment was concerned with expressive movements in number writing. Subjects were 56 university students. Ss were divided into two groups and required to write down numbers in two conditions, namely (a) at the sound of a hammer every 2-1/2 seconds; (b) as fast as they could: in this condition it was emphasised that Ss were being tested for speed and their task was to write down as many numbers as they could in three minutes. The two groups did the tasks in different orders to balance order effects. It is assumed that instructing Ss to work as fast as they could had an effect of increasing arousal, since Lindsley (7, p. 83-84) includes "mental set," "anticipation," "readiness instruction," and "a desire to compete with someone or oneself" as conditions inducing an increase in arousal.

The effect of increasing arousal on expressive movements was examined by measuring the length of the first ten numbers (i.e., the distance from the first number to the tenth) written down in the two conditions. The mean lengths were these: condition a: 8.5 cm; condition b: 6.8 cm ($t = 4.37$, $p < .01$). This result shows at a statistically significant level that increasing arousal reduces expressive movements and hence reduces psychoticism.

The Ss' scores were available on Eysenck's other two principal dimensions of personality, namely neuroticism and introversion-extraversion, as assessed by the Maudsley Personality Inventory (3). The correlations between neuroticism and expressive movements and extraversion and expressive movements were computed but were not statistically significant. This finding is in line with Eysenck's (2) previous findings on the independence of psychoticism from neuroticism and introversion-extraversion.

2. *The Second Experiment*

This experiment was designed to determine whether the effect in the first experiment could be repeated using a new sample of subjects and a different measure of expressive movements, namely the drawing-three-squares test (2, 4). Ss for this experiment were 45 female students. Ss were again divided into two groups and asked to draw three squares (a) in their own time, and (b) as fast as they could. (The two groups did the task in different orders to balance order effects.) Again there was a statistically significant decrease

in expressive movements in the heightened arousal condition. Mean average diagonals were: condition *a*: 23.70 mm; condition *b*: 17.68 mm ($t = 5.47$, $p < .01$). Expressive movements did not correlate significantly with either neuroticism or extraversion.

C. DISCUSSION OF RESULTS

Both experiments showed at a high level of statistical reliability that increasing arousal has the effect of decreasing expressive movements. Since expressive movements are a measure of psychoticism, the results lend support to the hypothesis that high arousal corresponds to low psychoticism. This hypothesis yields many predictions for further investigation, for example that other methods of manipulating arousal (e.g. by drugs) will have effects on expressive movements consistent with those reported here, and that other measures of Eysenck's construct of psychoticism will be found to be functions of levels of arousal.

More generally, since psychotics score highly on psychoticism (2), the results suggest that psychosis, or at any rate certain kinds of psychosis, may be explained in terms of low arousal. This conclusion is in line with that reached by several other investigators working at the problem from different approaches. A low arousal theory of certain kinds of schizophrenia has been advanced by Venables (12) and a somewhat similar theory of chronic schizophrenia in terms of low drive by Mednick (9). The work of Gellhorn (5) and Hoffer (6) showing low sympathetic reactivity in many schizophrenics also suggests a low arousal theory of psychosis, since sympathetic reactivity is a function in part of excitation in the reticular formation (e.g. 5). It is hoped that the present paper will do something to stimulate integration between these neurophysiological findings and the factor-analytic approach developed by Eysenck.

D. SUMMARY

The hypothesis is put forward that the concept of arousal corresponds to Eysenck's construct of psychoticism, individuals who are low on arousal being high on psychoticism. It is argued that this hypothesis can be confirmed if it can be shown that measures of psychoticism vary with variations of arousal. Of the three principal measures of psychoticism, namely speed of reaction, perceptual efficiency, and expressive movements, existing evidence shows that the first two are in part functions of arousal. There is, however, no evidence on the relation of arousal to expressive movements. Two experiments were therefore carried out in which arousal was manipulated and the effect on expressive movements examined.

It was found that increases in arousal had the effect of reducing expressive movements. The result supports the hypothesis that arousal corresponds to psychoticism.

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THE RELATION BETWEEN PARENT ATTITUDES AND PARENTAL ACCEPTANCE OF THE CHILD*¹

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A. INTRODUCTION AND PURPOSE

Much of parent-child research has been concerned with the effect of various parental factors on the child's personality and adjustment. Three main parent variables have been examined: parent behavior (child rearing practices), parent attitudes, and parent personality. In the present paper, data dealing with the second variable, parent attitudes, are analyzed.

The principal dimensions included in current parent attitude scales deal with parental attitudes toward a number of aspects of child rearing. While these are important variables to consider, probably of greater importance are the parental attitudes toward the child. Since undoubtedly the parent's attitude varies to some extent depending on the child, his attitude toward each individual child must be assessed rather than his attitudes toward children in general. Specifically, parental acceptance is considered of crucial significance for the child's personality development and adjustment. However, few research attempts have been made to develop an adequate measure of this important dimension. One paper-and-pencil test designed to assess parental acceptance of the child is available (5); unfortunately, no validity data for this instrument are published.

Several attempts have been made to link various parental attitudes toward child rearing to parental acceptance of the child. Medinnus (1) has suggested that strong parental independence-encouraging attitudes may indicate parental rejection of the child. While it may seem "self-evident" that certain parent attitudes are indicative of or diagnostic of nonacceptance (e.g., dominance, authoritarianism), such conclusions are unwarranted without further research evidence.

In the present paper, a measure of parental acceptance of the child is related to three factors obtained from the factor analysis of a current parent attitude scale.

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B. METHOD

1. *Subjects*

The 70 parents, 19 sets of parents of boys and 16 sets of parents of girls, in the present study were all parents of five-year-olds who were subjects in an investigation of school readiness. The mean *IQ* of the five-year-olds was 111.6 according to the Stanford-Binet (Form L) intelligence tests administered by the writer. The socioeconomic status of the families was approximately evenly divided between the upper-lower and lower-middle classes according to Warner's Index of Status Characteristics (9). The mean ages of the mothers and fathers were 32.1 and 34.1 years, respectively, and the corresponding mean years of education were 12.0 and 12.2.

2. *Measuring Devices*

The parent attitude scale employed was the Parent Attitude Research Instrument (PARI) developed at the National Institute of Mental Health. The development of the scale, its uses and reliability coefficients, have been described in some detail by the authors (6, 7). Other investigators (10) have factor analyzed the PARI scores of a normative sample composed of 222 mothers. Three main factors were identified: Factor A, Authoritarian-Control; Factor B, Hostility-Rejection; Factor C, Democratic Attitudes.

The measure of parental acceptance of the child was obtained from the parents' Q sorts on their five-year-olds. Each parent sorted independently two sets of items, one containing only positive traits or characteristics and the other only negative aspects of child behavior. Each pool of items consisted of 42 items typed on separate cards. The cards were sorted into seven piles ranging from "most characteristic of my child" to "least characteristic of my child," with six cards in each pile. This sort describing the parents' own five-year-old was labeled the "real sort." After these were completed, the parents sorted the cards to describe the "ideal" five-year-old; these were known as the "ideal sorts." The piles were numbered from six to zero, with six representing the most characteristic end of the continuum in the real sorts and the most desirable end in the ideal sorts. To obtain the measure of parental acceptance, the difference in placement of each item in the two pools between each parent's real and ideal sorts was computed; thus, the higher discrepancy scores indicate nonacceptance. Reliability over time of the Q sorts was obtained from 10 sets of parents who re-sorted the cards approximately four months after their initial sorts. The reliability correlations for the various sorts clustered about .55. The Q-sort study, including a list of the 84 items employed, is discussed in another paper (2).

3. Data Analysis

The parents' scores for the PARI subscales included in each of the three factors were summed: this yielded a score on each of the three PARI factors. While no factor analysis has been published of fathers' scores on this instrument, those scales on the father form which were identical with those on the mother form were used. Since probably such an analysis of scores for fathers would not result in the same clustering of subscales as the factor analysis of the mothers' scores, the present data for the fathers must be considered with some reservation.

Product-moment correlations were computed between the parents' PARI factor scores and their real-ideal Q-sort discrepancy scores.

C. RESULTS AND DISCUSSION

Although the principal concern of the study is the relationship between the three PARI factors and the measure of parental acceptance, the intercorrelations among the three PARI factors are listed in Table 1. The coefficients

TABLE 1
INTERCORRELATIONS AMONG THREE PARI FACTORS

Factors	B	C
Mothers		
A	.42*	— .11
B		— .26
Fathers		
A	.65**	.15
B		.21

* Significant at .05 level.

** Significant at .01 level.

are in the expected direction for the mothers with a positive correlation between the Authoritarian-Control factor and the Hostility-Rejection factor and negative correlations between each of these and the Democratic Attitudes factor. The latter correlations are not significant, however. For the fathers the r between Factors A and B is high and positive but the correlations between these and Factor C are also positive, although not statistically significant.

The correlations between the PARI factor scores and the real-ideal Q-sort discrepancy scores are tabulated in Table 2. Two of the six coefficients are significant, both in the expected direction.

It must be concluded that there is no invariable relationship between certain parental attitudes toward child rearing and the parent's acceptance

TABLE 2
CORRELATIONS BETWEEN PARI FACTORS AND REAL-IDEAL Q-SORT DISCREPANCY

Q-sort discrepancy	PARI factors		
	A	B	C
Mothers	.41*	.00	— .15
Fathers	.02	.09	— .35*

* Significant at .05 level.

of the child. This is in accord with Milton's (1958) factor analysis of the maternal behavior dimensions employed in a recent study of parent child rearing practices (8). A warmth factor orthogonal to a strictness or non-permissiveness factor led to the conclusion that the two are independent. The present data do suggest that for the mothers strong Authoritarian-Control attitudes are negatively related to child acceptance, while for the fathers, Democratic attitudes are positively related to child acceptance. General parental attitudes toward child rearing, the variables presumably measured in the PARI, stem probably from a variety of sources, such as current notions of parenthood, the parent's own childhood relationship with his parents, and basic personality variables. All of these may be distinct from the parent's attitude toward the child, specifically his acceptance of the child.

A closer examination is required of the meaningfulness of the variables included in current parent attitude scales and their ability to predict child behavior and adjustment. Several recent investigations (1, 4) have indicated that the PARI is not a particularly sensitive instrument in differentiating between the attitudes of mothers of various subgroups of children. These findings, coupled with the conclusion of the present investigation that there is little relationship between certain parental attitudes toward child rearing and parental acceptance of the child, would suggest that perhaps the effect of the latter dimension on child behavior might be the most fruitful one for future research concerns. The parental dimension of acceptance-rejection of the child may be a more potent determiner of child behavior than the parent's attitudes regarding specific child rearing practices.

D. SUMMARY

The relationship between three parent attitude factors and a measure of parental acceptance of the child was studied. Two of six correlation coefficients were significant. It was concluded that there is no invariable relation between certain parental attitudes toward child rearing and the parent's acceptance of the child. An examination of the effect of the latter variable on child behavior and adjustment was suggested as fruitful for future research.

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THE WAIS QUOTIENT OF SUBCULTURAL DEVIATION*

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A. INTRODUCTION AND THEORY

Today, more and more attention is being paid to the effect of subcultural influences on intelligence and personality. Cultural conflict is recognized as important in psychopathology (9, 11, 16). Cultural conflict occurs frequently in the marginal person who has adopted the values of the dominant culture and finds himself out of step with his subculture. The marginal man has probably internalized a cultural clash. More intensive research into this problem is currently roadblocked by inadequate clinical measurements, by lack of psychometric tools and even by ignorance of proper methodology.

It is well known that when a test like the WAIS (23) is administered to a subject, a constellation of traits known as a psychometric pattern is obtained. Until relatively recently, the belief persisted in clinical circles that it was possible to diagnose psychopathology on the basis of psychometric patterns (18). Critical evaluations have shown the WAIS psychometric patterns to be largely invalid in diagnosing pathology (17).

It is highly probable that many of the atypical patterns which appear on WAIS protocols can be attributed to subcultural influences. The same pattern may appear in different subcultural groups in a population for entirely different subculturally determined reasons. Both Jewish children and American Negro children (10), for example, do relatively poorly on performance as against verbal tests. Jewish children do so because the values of the Jewish subculture emphasize verbal learnings and denigrate performance arts. Negroes do poorly on performance tests because they emphasize speed (12), require an active attack on the problem (8) and the manipulation of unfamiliar hence frightening objects. It is well known that an active approach to the solution of one's problems is usually not encouraged in the culturally and socially deprived Negro homes (4). Therefore, when we administer various tests of intellectual ability to a representative sample from a given subculture, we find a constellation of intellectual traits reflecting the predominant values in that subculture (13, 14, 21).

Today, however, we also have a misconception that from an analysis of a

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psychometric pattern, one might obtain clues which would lead to a more definite diagnosis of mental deterioration. The Wechsler deterioration quotient is thus based on the notion that a statistically determined critical difference between two or more tests measuring different "mental" abilities gives the psychologist the key to the riddle of the diagnosis of mental deterioration.

There is no clear definition of what is meant by mental deterioration. Neither is any note taken of the fact that these tests were not selected for their ability to predict the nebulous assumptions of measuring mental deterioration but were chosen because they are good tests of intelligence. A decline in these test scores does not necessarily imply mental deterioration.

That, in our culture, there is a differential rise and fall in abilities is known. Wechsler (23) discusses these growth curves at great length and documents them quite ably, but he attributes the ascent and decline in abilities as largely due to the ageing process. For example, Wechsler claims that certain tests hold up with age and that others do not. While there is no denial that during childhood and adolescence certain factors do bring about a differential rise in functioning on tests, whether these factors still operate after adolescence, is problematical. The assumption is that the decline is for the same reason at various age levels. This is contraindicated by the finding that with age there is a change in the factorial composition of the WAIS (5).

Wechsler applied the findings regarding differential rates of growth and decline of test abilities to the study of mental deterioration and devised a deterioration quotient based upon the "differential test score method." The formula for the deterioration quotient is *Hold* tests minus *Don't Hold* tests, divided by *Hold* tests. The original *Hold* tests for Wechsler-Bellevue were Information, Comprehension, Object Assembly, and Picture Completion; and for *Don't Hold* tests were Digit Span, Arithmetic, Digit Symbol and Block Design. An examinee was presumed to show definite mental deterioration if the loss exceeded the one due to normal decline with age by 20 per cent (22).

If one were to follow Wechsler's statistical reasoning, it would appear that normal deterioration is similar to deterioration due to generalized brain damage. The only distinction made would be in terms of degree. This has not been substantiated by research. Studies have shown that the Wechsler-Bellevue deterioration quotient (*DQ*) was invalid (1, 3, 6). A recent study, however, does report that *WBDQ* gives a prediction of organic pathology which correlates rather well with psychiatric diagnoses (7). When we examine this study critically, we note that *WBDQ* was modified to exclude

Object Assembly and Information. Yet Wechsler's allowances for decline with age were used. We feel that in this case the *DQ* obtained *accidentally* corresponded with the characteristics of the group and the psychiatric diagnosis. However, even though research indicated that the Wechsler-Bellevue deterioration quotient was not useful in the ordinary clinical situation, Wechsler still felt that it was clinically useful and worth while resurrecting.

With the appearance of the WAIS (23), the deterioration quotient was revised. A somewhat different combination of tests was included in the *Hold* category: viz, Vocabulary, Information, Object Assembly and Picture Completion; and in the *Don't Hold* category: Digit Span, Similarities, Digit Symbol, and Block Design. Since age scaled-score-equivalents were used in computing the deterioration quotient, there was no longer any need to make an allowance for the normal decline with age. Nevertheless, the current deterioration quotient appears to be no more satisfactory than its predecessor. Wechsler notes that in approximately 50 per cent of the "normal" population (23, p. 213), there is a negative deterioration score, that is, the sum of the *Don't Hold* tests is greater than the sum of the *Hold* tests. He suggests that this ratio be disregarded. He suggests that the negative deterioration score has some meaning, "although what it is remains to be investigated" (23, p. 213).

Wechsler notes that in the deterioration quotient the "mean percentage of loss for any age group and the entire population approximates zero, as was to be expected" (23, p. 212). Why should one naturally *expect* to find these results? It is well known that with age there is a greater increase in brain pathology, neoplasms, etc. (2) than is allowed for solely by age factors. If the *DQ* is truly a *DQ* and not a statistical artifact, the mean should be anything but zero! Because of the way it was derived it can only be a statistical artifact and cannot give us more than we put into it. How else can one expect to find a normal distribution unless chance factors operate to produce the error curve with a mean of zero? We submit that one of the chance factors, and a very important one, is the subcultural determination of mental abilities. In a culture such as ours, many subcultures compete and influence the intelligence of the various segments of our population. An accurate sampling of these conglomerate abilities will give a statistic which is meaningless for any one particular subject in terms of describing his own constellation of abilities, and when worked further will bring forth such statistical monstrosities as negative deterioration scores. However, if the *DQ* is looked at not in terms of any kind of pathology but in terms of deviation from the mean, we can state that it indicates that a significant section of the

population has certain subcultural bias which is not typical. Even if examined from the point of view of being a subcultural quotient, the current WAIS *DQ* leaves much to be desired.

The reasons for our belief are the following:

1. The critical question is whether it is possible to determine the common basis of experience for all adults upon which subtests could be standardized. Is it possible to arrive at a *DQ* through any such subtests? In fact the validity of intelligence tests for adults needs reevaluation since adult experiences become so variegated and differentiated that it is difficult to find a common background of experience to determine intellectual acumen, ability or disability.

Adults develop increasingly sharper differences in skills, interests, behavior patterns, etc. because adult life involves people in the infinitely different experiences possible in college, careers, business, marriage, travel, politics, community affairs, hobbies and child rearing, to mention but a few. Added to these normal variations are many others for members of minority groups or deviant subcultures. Along the road to maturity, many childhood skills and interests are lost, often to be recaptured in later life. But by the same token, some of the skills acquired during the competitive middle years may also be forgotten a few years after retirement because they are no longer needed. It would appear that people are prone to return to many aspects of childhood as old age approaches, which would imply for members of a subcultural group a return to the early folkways of his group.

This factor is often neglected when intelligence tests are administered to the aged. It is entirely possible that because subcultural influences are most potent during early childhood and in later life, disparities in various tests do not reflect decline with age, but emphasize other factors, one of which may be subcultural influences.

2. In order to have a measure of decline, one must have a measure or an index of the subject's previous function. This is most difficult to secure for a person who does not have previous test data. Even guessing at what his previous standing may have been is hazardous unless data is available for his age, subcultural background, etc. Even if this were available, the constantly changing subculture, with different experiences and abilities being called into play, may make such data obsolete very rapidly. We must remember that each subculture is part of a constantly changing and dynamic general culture. There is a constant shift in occupational distribution and education of members of this group. We cannot, for example, ascribe differences between the scores found on verbal and performance tests, when these tests are given

simultaneously to twenty-year-olds and forty-year-olds, as due to deterioration with age. Other more important factors may be involved. As mentioned above, differences in education, occupation, living standards, mass media, etc. play a great role. Even when one is trying to avoid this artifact by basing the *DQ* on a restricted age population, the results are not valid as the restricted age grouping is composed of subjects from varying subcultures. Even assuming that all the above artifacts have been ironed out, how do we know that the tests showing the greatest decline are necessarily those most sensitive to pathology?

3. The WAIS subtests are not equally meaningful to all persons who take them. In other words, the person tested should respect the test presented to him and should exert himself to the full in order to present the psychologist with an optimum performance. This would presuppose that the examinee realizes that the test measures an ability which is important in life and is considered valuable in his subculture.

4. The WAIS subtests do not actually measure abilities that are functional and meaningful at various developmental periods. To a school child, schooling is the most important activity, hence, test items measuring school progress are most important. During the person's productive life, tests predicting ability to achieve in life's work are most important. Later on, tests measuring ability to achieve success in avocational activities are important (after retirement). Since the importance of these tasks and the time spent on them vary from infancy to old age, the tests must similarly vary. Therefore the abilities measured by the tests, and the purpose of testing vary so much that, of necessity, different items have to be chosen for the scales. We cannot have the same test items used throughout the life span. WAIS type tests are thus inadequate for the purpose of developing a *DQ*.

The question arises whether or not we can use these differences among various subtests to derive a workable test of subcultural deviation. We suggest that most of the difficulties inherent in the above may be eliminated by selecting for one particular age, sex, and specific subculture the high and low tests in the WAIS. We assume that a person learns throughout his lifetime. Different methods of learning, of approaching tasks, of attitudes toward tests, of expectancy sets which are influenced by the subculture will show in the test scatter. To reflect these changes, there will be different intercorrelations of tests at various ages. These will not necessarily be affected by the "ageing" process. It is true that we would have preferred another assortment of tests, i.e. factorially pure tests, than the ones given by Wechsler, but, for the want of anything better, one has to work with what is available.

To us it appears that if we were to administer the WAIS to a group of subjects who came from the same subculture and then established a ratio based upon tests that hold up in the subculture and tests that do not—similar to the *DQ*—and then established norms of subcultural deviation, we would have a tool which might give us answers to important questions. A person who would have positive cultural deviation (plus one sigma) would most likely indicate that he has become so immersed in his own subculture that he is very much out of tune with the general culture and hence presents a problem. The person on the other hand who has negative cultural deviation (minus one sigma) (similar to what Wechsler calls negative mental deterioration), would indicate that he also has a problem. While he is in tune with majority culture he is out of step with his own subculture and probably internalized a cultural clash. He is our so-called *marginal man*.

We decided to try out our theory on a group whom we previously studied and knew very well.

B. PROCEDURE

We examined the *DQs* of a Jewish aged group previously studied (15, p. 64, Table 6). This group consisted of 50 men and women matched for full WAIS *IQs* and of somewhat similar socioeconomic backgrounds. The full WAIS *IQ* for the group was 93.88 with an *SD* of 14.07. The mean age for the men was 68.62 with an *SD* of 5.62 and for the women, 68.76 with an *SD* of 5.73.

Table 1 shows the age scaled scores of the equated sample of Jewish aged men and women. We computed the *DQs* of this population based upon Wechsler's formula and found the mean to be $-.92$ with an *SD* of 20.52. More than 50 per cent of our cases had a "negative" *DQ*.

We then computed the WAIS Quotient of subcultural deviation for both the men and women of our group. The *Hold* tests for the males are Comprehension, Arithmetic, Digit Symbol, and Picture Completion, and for the females are Comprehension, Arithmetic, Digit Symbol, and Block Design. The *Don't Hold* tests are the same for both groups. These are Similarities, Vocabulary, Picture Arrangement, and Object Assembly. The mean WAIS *QSD* for the males ($N = 48$) was 26.52 with an *SD* of 19.23. The mean WAIS *QSD* for females ($N = 45$) was 24.39 with an *SD* of 16.31. The difference of 2.13 is statistically insignificant.

The relation of WAIS *QSD* to present level of intelligence was tested by correlating WAIS *QSD* for the entire group with full scale WAIS *IQ*. The correlation was $-.05$, which is statistically insignificant.

TABLE 1
THE MEANS OF THE VERBAL AND PERFORMANCE TESTS OF AN EQUATED SAMPLE
OF JEWISH AGED MEN AND WOMEN

Tests	Male		Female		SD
	No.	Mean	No.	Mean	
<i>Verbal</i>					
Information	50	10.12	50	9.30	2.55
Comprehension	50	11.26	50	10.92	3.52
Arithmetic	50	10.58	50	9.66	2.78
Similarities	50	6.88	50	8.70	2.86
Digit span	50	9.90	50	9.24	3.48
Vocabulary	49	8.53	49	8.67	2.82
<i>Performance</i>					
Digit symbol	48	8.98	48	9.13	2.93
Picture completion	50	8.20	50	8.28	2.99
Block design	50	7.44	50	8.52	2.78
Picture arrangement	48	6.58	48	7.85	3.40
Object assembly	49	6.94	49	8.04	2.81

It seems to us that the best although crude index of acculturation for our group would be a comparison of the formal educational level achieved with the WAIS *QSD*. Twenty-nine males and 33 females had less than eighth grade education. Their mean WAIS *QSD* was 33.5 and 27.62 respectively. Since the difference between these means was statistically insignificant, we combined the two distributions and thus had 62 cases whose mean *QSD* was 30.37 with an *SD* of 19.42. This was group I. Thirty-one cases (19 males and 12 females) had eight grades of grammar school or more. Their combined WAIS *QSD* was similarly 15.5 with an *SD* of 12.45. This was group II. The difference of 14.87 between the means of the two groups was at the .001 level of confidence.

To check further on WAIS *QSD* as valid measures of subcultural deviation for our sample, we examined our records and found that those individuals who deviated one sigma or more from the mean of the group were usually also cultural deviants. Those who had a positive *QSD* of more than one sigma were usually also those who had less schooling and less exposure to the American culture; those who had a negative *QSD* of more than one sigma usually were those who were better educated and of somewhat higher cultural background than the rest. We have no data to learn whether these subjects also deviated in other ways.

C. DISCUSSION

We realize that our WAIS *QSD* is rather crude and subject to many of the criticisms we leveled against the WAIS *DQ*. The *age scaling process itself*, since it is based on general norms, brings in undesirable deviations. A single quotient, no matter how well derived, cannot alone bear the entire burden of diagnosis. We are also aware of the fact that since the tests we used may not be the most appropriate ones, our WAIS *QSD* leaves much to be desired. However, our effort is merely suggestive. It is to be recalled that our method sets up no arbitrary definitions of "normality." The distribution found for a specific population determines its limits. Surely studies made with the WAIS or other similar tests suited for this purpose may be productive of a more predictive *QSD*. It is to be remembered that the establishment of such indices requires the establishment of local population norms. It is only on the basis of such norms, plus other criteria, that such an index of a subcultural maladjustment may be validated.

D. SUMMARY AND CONCLUSIONS

It is suggested that Wechsler's Deterioration Quotient is a crude quotient of a subcultural deviation (*QSD*) thus accounting for its poor prognostic accuracy. A proposal is made for deriving a WAIS *QSD* based upon local population norms equated for age, socioeconomic status, sex, and subcultural background.

An illustrative example is offered of such a quotient based upon a study of an equated group of Jewish aged men and women, indicating the potential usefulness of WAIS *QSD*.

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A STUDY OF BODY IMAGE IN CHILDREN WITH CLEFT PALATE AND CLEFT LIP*

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A. PROBLEM

Machover (6) has stated that various physical disabilities will be evidenced in drawings of the human figure—often directly represented. However, a number of studies of orthopedic disabilities in which figure drawings were used (9, 11, 12, 13) have yielded equivocal results. A study by Abel (1), on the other hand, demonstrated that Ss with severe facial disfigurements tended to represent the disfigurement in their drawings more often than did Ss with mild disfigurements. Perhaps a major problem in some of these studies has been the lack of objective scoring criteria which might lead to more reliable results.

Fiedler and Siegel (3) and Richey and Spotts (10) have used adaptations of the Goodenough (+) scoring criteria for the study of personality variables. The results of these studies suggest that the Goodenough criteria may provide fairly objective means of rating figure drawings for purposes other than those of intellectual evaluation. It might be assumed that personality variables other than intelligence influence Goodenough scores to a greater extent than they influence scores on other standard tests of intelligence.

A number of studies appear to lend support to this assumption. McHugh (7), using normal children, and Birch (2), using older mentally defective children, found significant relationships between the Goodenough Draw-A-Man test and the 1937 Revised Stanford-Binet. Hanvik (5), however, found no significant relationship between Goodenough IQs and IQs from the Wechsler Intelligence Scale for Children in child psychiatric patients. Moreover, Ochs (8) found that as child patients at a state hospital improved in social adjustment, their scores on the Goodenough drawings increased. The scores of those who showed no improvement tended to decrease. One might conclude from these results that Goodenough Mental Ages would be nearly

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equivalent to those obtained from a test such as the Stanford-Binet in a group of "normal" children. However, a discrepancy between these two measures, with Goodenough *MA* being lower, would be anticipated in children who have either emotional problems or physical handicaps which may lead to perceptual distortions of the body image.

These considerations would suggest the use of a difference score—standard intelligence test score minus Goodenough score—as a fairly objective index of body image distortion. The only occasion where such an approach would be unnecessary is that in which a matched pair design is used—a condition which is often difficult to meet in practice. The present study adopts the difference score approach in studying a group of children with cleft lip and palate and a group of "normal" children.

B. METHOD

1. *Subjects*

Twelve children with cleft lip and palate—seven boys and five girls—from a special class for physically handicapped children, were studied. All of the children had undergone surgical repair of their handicap. However, noticeable scarring and speech impediments were present in every case.

Another group of 12 children—eight boys and four girls—were selected from a large group of new entrants into the school system who were seen for routine testing. They were selected by their proximity in chronological age and Binet Mental Age to the cleft palate group, but it was not possible to match them. These children had no known psychological difficulties. Although it was not possible to control carefully for socioeconomic status, all of the children came from similar areas within the city. These areas would be predominantly lower middle class in composition.

2. *Procedure*

The 1937 Revised Stanford-Binet, Form L, and the figure drawings were administered to each child in the same session with the Binet being administered first. One of us (P.L.C.) administered all of the tests. Machover's (6) instructions for drawing a human figure were used in preference to those of Goodenough (4). Consequently, only same-sex figures were used. The data for the "normal" group had been collected and scored prior to the beginning of the investigation. The figures for the cleft palate children were scored according to Goodenough's norms by both authors independently. There was complete agreement in nine cases, a one-point discrepancy in one case and a two-point discrepancy in two cases. The dis-

crepancies were settled by agreement between the writers without reference to other data on the children. The index of body image distortion used was Binet *MA* minus Goodenough *MA*.

Since Machover (6) has suggested that deformities will often be directly or indirectly represented in corresponding parts of the figure drawing, the drawings of the cleft-palate group were rated independently by each author to test this hypothesis. A five-point scale (adapted from Abel, 1) with the following categories was used:

1. Specific portrayal of the disfigurement (i.e. a cleft drawn in the lip or nose area).
2. Distortion of the mouth area while other body parts are undistorted.
3. Distortion of other facial features while other body parts are undistorted.
4. Overemphasis on facial detail as opposed to other body parts.
5. Face no more distorted than the rest of the body.

There was complete agreement between the authors on these ratings.

C. RESULTS

The data are presented in Table 1. The two groups were *not* significantly different in either chronological age or Binet Mental Age. The differences between Binet *MA* and Goodenough *MA* were first tested for each group separately with *t* tests for correlated means. These differences were significant for the cleft-palate group but not for the "normal" group. A *t* test of the differences between the index scores—Binet *MA* minus Goodenough *MA*—for the two groups was significant at less than the .02 level (see Table 1).

The ratings of the cleft-palate drawings gave 10 drawings a rating of five and two drawings a rating of four. None of the children in this group specifically portrayed their deformity or distorted the face area more than the rest of the figure.

D. DISCUSSION

The results appear to support the hypothesis that distortions of the body image will be reflected in Goodenough scores. Hence, an index based upon the discrepancy between this score and that obtained from an intelligence test such as the Stanford-Binet may prove generally to provide more reliable results than some of the older methods of rating drawings of the human figure.

It is possible to extend the use of this method to areas of interest other than that of physical handicaps. It would also be of interest to study the differences between handicapped children who show discrepancies between the two measures and those who do not. A further area for exploration

TABLE 1
COMPARISON OF THE VARIOUS MEASURES FROM THE TWO GROUPS

		Cleft-palate group	Normal group
Chronological Age (months)	Range	73 to 94	73 to 105
	Mean	83.67	87.42
	<i>SD</i>	7.62	8.09
	<i>t</i> (<i>df</i> = 22)		1.119
	<i>p</i>		>.20
Binet Mental Age (months)	Range	73 to 108	72 to 106
	Mean	89.25	84.83
	<i>SD</i>	10.27	10.69
	<i>t</i> (<i>df</i> = 22)		.989
	<i>p</i>		>.30
Goodenough Mental Age (months)	Range	66 to 102	72 to 105
	Mean	78.92	85.75
	<i>SD</i>	8.99	9.91
Difference (Binet <i>MA</i> minus Goodenough <i>MA</i>)	Range	-8 to 32	-9 to 5
	Mean	10.33	-.92
	<i>SD</i>	13.47	3.84
Within groups	<i>t</i> (<i>df</i> = 11)	2.544	.793
	<i>p</i>	<.05	>.40
Between groups	<i>t</i> (<i>df</i> = 22)		2.666
	<i>p</i>		<.02

would be that of extremely well adjusted children. If the index is truly one indicating adjustment, we might expect discrepancies in the opposite direction for such children.

The present results provide little evidence to support the contention that physical handicaps will be directly represented in figure drawings. On the contrary, the writers were struck with the *overall* poor quality of the drawings from most of the cleft-palate children. Our results do support the assumption that figure drawings will reflect distortion of the body image, and that is sufficient to make the figure drawings a useful clinical and research instrument. However, the data suggest that a great deal of caution must be used in applying the kind of interpretation which Machover (6) has advocated.

E. SUMMARY

An attempt was made to justify the use of an index discrepancy score—Binet *MA* minus Goodenough *MA*—in rating children's figure drawings. This method was applied to a group of 12 children with cleft palate and cleft lip and to a group of 12 normal children. The difference in index scores between the two groups was significant. Some implications for further use of this method were discussed.

The assumption that handicaps will often be directly represented in drawings was also discussed. The results of the study provided no support for such an assumption.

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SUPPRESSION OF LEARNED AVOIDANCE AND DISCRIMINATIVE RESPONSES IN THE RAT BY CHLORDIAZEPOXIDE (LIBRIUM) AND ETHANOL-CHLORDIAZEPOXIDE COMBINATIONS*

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A. INTRODUCTION AND PURPOSE

In an earlier experiment with rats, we have proposed that a tranquilizer should promote a suppression of learned avoidance responses to an anticipated stimulus ("anxiety") but such a drug should not affect the animal's capacity to select a proper choice of escape (discriminative responses) from a shocking stimulus (1).

Chlordiazepoxide (librium) is a new chemical agent with a primary depressant action on the central nervous system. It has many diverse properties including anticonvulsant action and muscular relaxation (6, 7). The primary pharmacologic effect of chlordiazepoxide is that it obtunds "anxiety" at dosages which do not produce sedation or hypnosis.

Alcohol has been popularly suggested to be a tranquilizer. Results from our laboratory indicate that ethanol will "reduce anxiety" in animals only when performance is measurably altered (2).

The purpose of the present experiment is to investigate the effect of chlordiazepoxide as well as chlordiazepoxide-alcohol combinations on learned avoidance and discriminative responses in the rat. The results may serve as a comparison to other ataraxics. In addition, the results of combination of alcohol and chlordiazepoxide may indicate whether or not addition, antagonism or potentiation results by such combined treatment.

B. MATERIALS AND METHODS

An attempt is made to develop a method for quantitating "tranquilization" in rats. Male albino weanling rats of Wistar stock were used as subjects. The average weight was 55 grams. The animals were trained three times daily (three trials each time) until they were 100 per cent proficient. The

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experimental training box consisted of a large main compartment with a shocking grid floor. When a warning light was lit, the animals could escape from this compartment in two manners. An incorrect choice of escape led to a compartment which also had a shocking grid floor. The proper choice of escape was via the other exit leading to a compartment with an insulated flooring. Details concerning the construction of the cage can be found in a previous publication (3).

A selective action of tranquilizers has been described (1). The suppression of avoidance behavior is produced with less alteration in correctness of escape patterns (discrimination). A "tranquilization index" can be calculated. This index represents the difference between suppression of learned discriminative behavior and avoidance behavior. This derived number can be either positive or negative. If the avoidance responses are diminished more than that of propriety of choice, the number will be positive. This indicates tranquilization by our operational procedures, and the higher the tranquilization number, the more selective is the anxiety reducing capacity of the drug. A negative number has been found with barbiturates and other nonataractic depressants (2).

When all rats were trained to escape the impending shock *correctly*, they were divided into the following experimental groups:

Group A. These rats received 0.5 g/kg of ethanol intraperitoneally. They received three trials every 15 minutes thereafter for four hours. Total subjects, 10 rats. Total trials, 480.

Group B. These rats received 10, 20 or 30 mg/kg of chlordiazepoxide intraperitoneally. They were then tested every 15 minutes for four hours using 10 rats per dosage level. Total, 30 subjects—480 trials per dosage level. Total trials, 1440.

Group C. These animals received ethanol (0.5 g/kg and 10, 20 or 30 mg/kg of chlordiazepoxide) and tested as before using 10 rats per dosage level. Both drugs were administered intraperitoneally. Three groups, 10 rats per group, 480 trials per group. Total trials, 1440.

C. RESULTS

Figure 1 illustrates the calculated four-hour tranquilizing action of chlordiazepoxide in a dosage of 10 mg/kg. The tranquilizing potency is minimal at this dose. In fact, during the first-hour period a slight nonataractic depressive state resulted. After this, a positive value was obtained during each of the four one-hour periods. When alcohol was administered concomitantly, there was a reduction in the tranquilization index. Although the reduction in

avoidance responses was still evident, there was a greater reduction in the animal's ability to discriminate or make the learned choice in escape. Alcohol failed to demonstrate anxiety reducing properties unless there was also a reduction in the number of correct escape choices. This is illustrated in Figure 1 by the depressant state induced by alcohol alone.

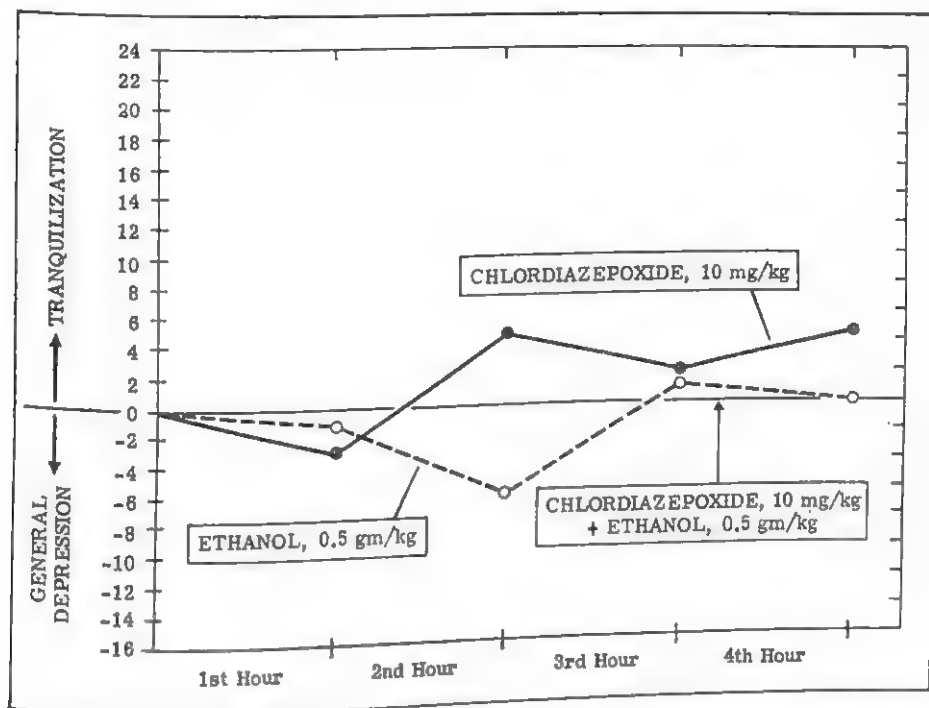


FIGURE 1
CHLORDIAZEPOXIDE (10 MG/KG) AND CHLORDIAZEPOXIDE-ETHANOL COMBINATION ON ANXIETY-DISCRIMINATION DIFFERENTIAL

A larger dosage of chlordiazepoxide, 20 mg/kg, was administered intraperitoneally to a new group of rats (Figure 2). A much higher index of tranquilization was produced. The index was diminished if alcohol was administered at the same time as the tranquilizer. The reason for this change in responsiveness was the decrease in the difference between anxiety reduction and performance (discrimination). The rats still failed to respond to the warning light; and even when they did respond to shocking stimulus, they did so incorrectly; i.e., they escaped to the compartment wherein a punishing shock was administered.

The highest dosage level (30 mg/kg) of chlordiazepoxide produced results

very similar to that of the intermediate dosage. The only marked difference noted occurred during the fourth hour, when "tranquilization" was effected as illustrated in Figure 3. Another prominent difference in response was that 30 mg/kg effected a tranquilization profile which was not as readily reversible

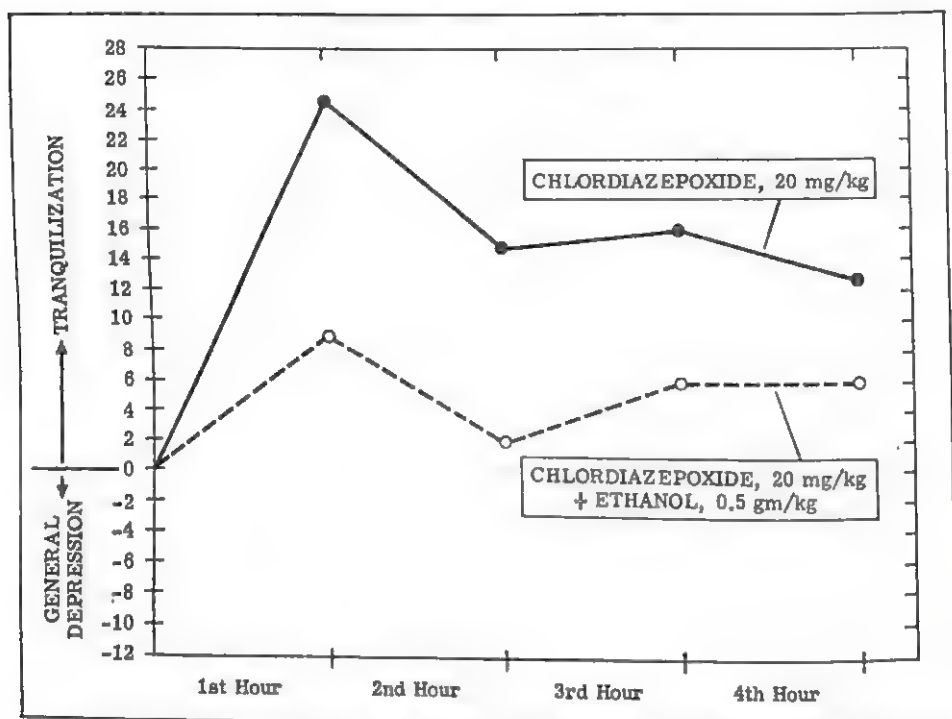


FIGURE 2
CHLORDIAZEPOXIDE (20 MG/KG) AND CHLORDIAZEPOXIDE-ETHANOL COMBINATION ON ANXIETY-DISCRIMINATION DIFFERENTIAL

as that resulting from the administration of 20 mg/kg. This largest dose of chlordiazepoxide evidently overrode any tranquilizer-inhibiting property of ethanol. In any case the additive action, which one might expect if the two drugs were tranquilizers, did not appear.

The calculated four-hour tranquilization index for each of the different levels of chlordiazepoxide, alcohol or combinations appear in Table 1. TS is reported as per cent of trials in which the animals were completely unresponsive; i.e., they reacted neither to anxiety nor to painful stimuli. When one effects a TS value of 14 per cent, as is recorded for the highest dosage, it is possible that a near anesthetic drug level of the drug has been reached.

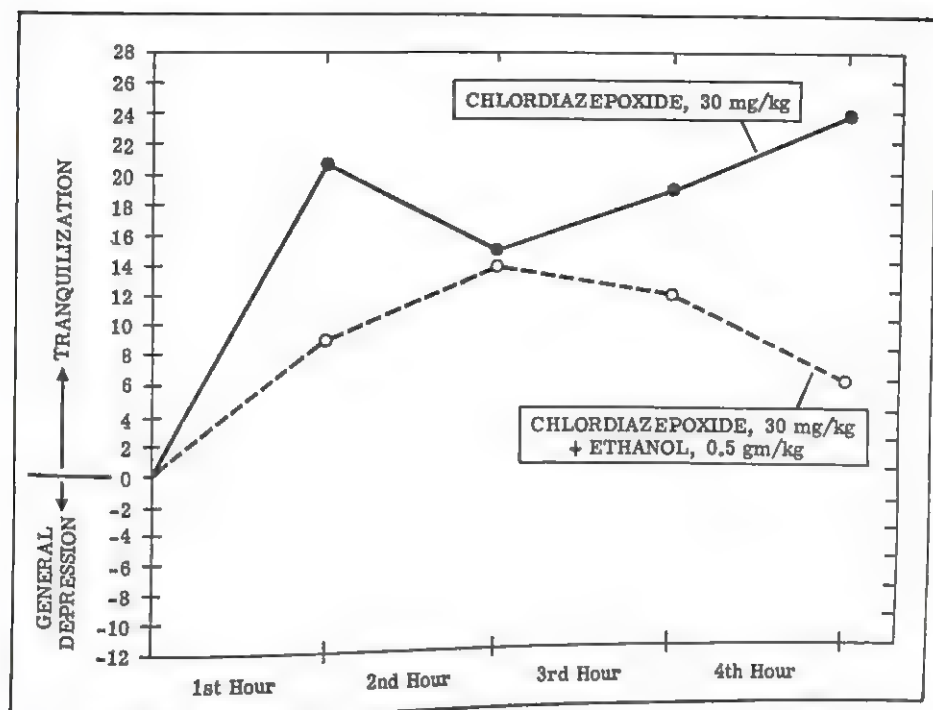


FIGURE 3
CHLORDIAZEPOXIDE (30 MG/KG) AND CHLORDIAZEPOXIDE-ETHANOL COMBINATION ON ANXIETY-DISCRIMINATION DIFFERENTIAL

TABLE 1
TRANQUILIZATION INDEX (TI)^a AND PERCENTAGE TAKE SHOCK (TS)^b

Drug levels chlordiazepoxide		No alcohol	Alcohol 0.5 gm/kg
None	TI	0	-5
	TS	0%	0.2%
10 mg/kg	TI	9	0
	TS	0.6%	0%
20 mg/kg	TI	68	23
	TS	8%	7%
30 mg/kg	TI	81	37
	TS	14%	7%

^a Tranquilization Index: Calculated as discrimination or choice score less anxiety score.

^b Take Shock: Percentage of trials in four-hour period in which animals failed to either stimuli and took shock.

D. DISCUSSION

The data in this experiment demonstrate that chlordiazepoxide (librium) has properties which classify it as a tranquilizer. It has a capacity to reduce

reaction to anxiety inducing stimuli for four hours or more. The optimum dosage is 20 mg/kg, eliciting reduction in anxiety responses with minimal reduction in choice selection (discrimination). These general results have been previously obtained with chlorpromazine, reserpine, meprobamate and hydroxyzine (1). In comparison to these latter drugs chlordiazepoxide in a dosage of 30 mg/kg gave a higher tranquilization index than has been reported by us with more than optimal dosages of reserpine (1 mg/kg), chlorpromazine (5 mg/kg) or meprobamate (150 mg/kg). In an intermediate dosage, 20 mg/kg, chlordiazepoxide had a higher tranquilization index than reported with reserpine (0.5 mg/kg) but less than intermediate dosages of hydroxyzine (10 mg/kg), chlorpromazine (2 mg/kg) or meprobamate (100 mg/kg).

All of the effective dosages of chlordiazepoxide were readily reversible by ethanol. The dosage of ethanol used was enough to cause only moderate increases in the blood alcohol levels. The highest concentration was in 15 minutes after injection, at which time injected rats paired with the experimental rats showed a mean blood alcohol concentration of 44 mg per cent, and this returned to negligible concentrations (5-8 mg per cent) by 75 minutes after injection. However, the effects of the alcohol persist and cause a reversion of the tranquilizing action of chlordiazepoxide long after alcohol can be demonstrated in the blood.

If alcohol is a tranquilizer, it might be expected that a behavioral pattern in rats could be effected that would be similar in some respects to that of a tranquilizer. Under our experimental conditions, alcohol demonstrates properties that are more typical of nonataractic depressants such as the barbiturates.

A recent report indicates the usefulness of chlordiazepoxide during the acute withdrawal phase from alcohol (5). It could be inferred from our data that untoward changes in human behavior might possibly ensue from the combined use of this tranquilizer and alcohol unless it were used a reasonable time after alcohol had been withdrawn.

E. SUMMARY

The effects of chlordiazepoxide, ethanol and chlordiazepoxide-ethanol combinations in rats have been studied using a modified shock-avoidance box. It was found that 20 mg/kg or 30 mg/kg of chlordiazepoxide produced suppression of learned avoidance responses with little change in discriminative responses. Alcohol caused reduction in avoidance responsiveness only when a diminishment in performance (discrimination) resulted. The administration

of alcohol in small amounts to chlordiazepoxide-treated rats caused a reversal of the avoidance reducing property of this tranquilizer. This inhibition of the action of chlordiazepoxide lasted longer than the period in which alcohol could be demonstrated in the blood.

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THE EFFECT ON AVOIDANCE RESPONSE EXTINCTION IN RATS OF CS CONTINUATION AND EMOTIONAL CONSTITUTION*

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A. INTRODUCTION AND PURPOSE

It is well established that CS termination by the CR is necessary for optimal acquisition of an avoidance CR (6, 7, 8, 9, 10). It may be predicted that an extinction procedure in which the CS continues beyond the CR produces quicker extinction than one in which the CS terminates the CR as in acquisition. Haruki (4) has confirmed this prediction. It is further tested in the present experiment with a different situation and a different procedure.

Rats from the eleventh generation of the Maudsley Reactive and Non-reactive strains constituted the two levels of the variable emotional constitution. These strains are the product of selective breeding on the basis of defecation scores on a revised standardised version of Hall's open-field test. A detailed account of this version and of the breeding and rearing of the strains may be found in Broadhurst (1).

B. METHOD

1. *Subjects*

The Ss were male rats, 14 from each of the two Maudsley strains, naive apart from their open-field testing, in which the difference in defecation between the groups was significant beyond the .001 level by *t* test.

2. *Apparatus*

A conventional shuttlebox was used, divided into two by a partition with a doorway in it. The illumination within was 4 f.c. at floor level. The US, electric shock, came from a matched-impedance circuit of the type advocated

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by Campbell and Teghtsoonian (2) set at 125 volts A.C., the polarities of the grid bars being changed by a commutator. The CS was a buzzer of intensity 45-47 db (ref. .002 dynes/sq. cm.) at floor level.

3. Procedure

Acquisition and extinction were carried out in one session. After a three-minute adaptation period, the CS was presented five times alone for 10 seconds at minute intervals to determine its neutrality for the animal. In the experiment, the CS came on and was followed five seconds later by the US. The *E* terminated the CS (and the US) as soon as the *S* had passed through the doorway. If the *S* crossed before five seconds had elapsed, the *E* terminated the CS and no US followed. This procedure was continued at minute intervals until five successive avoidances had occurred. Extinction was then inaugurated, the CS being presented until five successive failures to respond within five seconds of CS onset occurred. For extinction, each strain was randomly assigned to two groups treated as follows: for one, CS-termination group, the CS terminated if the *S* crossed within five seconds of CS onset; otherwise as soon as five seconds had elapsed. For the other, CS-continuation group, the CS continued 20 seconds beyond the *S*'s crossing if this occurred within five seconds of CS onset; otherwise the CS terminated at five seconds. Response latencies were recorded to 1/20th of a second.

C. RESULTS

Analysis of variance was not applied as the extinction data were found to be skewed with considerable heterogeneity of variance not yielding to transformation. A nonparametric test was therefore used, the Mann-Whitney *U* test, one tailed.

TABLE 1
RESULTS: EXTINCTION PROCEDURES
(Units are number of trials to extinction from acquisition criterion)

Group	CS-termination Mean	CS-continuation Mean	<i>U</i>
Strains combined	29.6	12.5	56.5*
Reactive strain	18.1	7.3	16.5
Nonreactive strain	41.9	17.7	9.5*

* $p < .05$.

Table 1 shows that there was a significant difference between the extinction procedures in the direction confirming the prediction, though the suggestion is that the procedures affected the strains differentially.

TABLE 2
RESULTS: STRAIN DIFFERENCES IN ACQUISITION AND EXTINCTION
(Units as shown)

Measure	Reactive Mean	Nonreactive Mean	U
Number of trials to acquisition criterion	43	23.2	50*
Number of trials to first avoidance	9.6	8.0	84
Ratio: $\frac{\text{No. of avoidances to acquisition criterion}}{\text{No. of US after first avoidance}}$	.38	1.46	21**
Number of trials from acquisition to extinction criteria	12.3	29.8	32**

* $p < .025$.

** $p < .001$.

Table 2 shows that there were significant differences between the strains both for acquisition and extinction, but in opposite directions, the reactive strain being slower in acquisition and more rapid in extinction, which accords with the general finding in conditioning studies of an inverse relation between ease of acquisition and extinction (5, pp. 118-119). These differences were significant independently of the extinction procedures.

The only significant latency difference was one between strains. This was for the first avoidance on which the nonreactive strain had the shorter mean latency (reactive group: mean 3.13; nonreactive group: mean 2.31, $p < .05$).

D. DISCUSSION

The CS-continuation procedure might have produced quicker extinction (a) by not giving further secondary reinforcement, which CS termination is usually postulated to give; and/or (b) by making the CR no longer instrumental to CS termination so that, like behaviour proving noninstrumental to a primary goal, the CR tended not to recur; this presupposes that CS termination had become a goal; and/or (c) by allowing new learning, namely, that no shock followed even though the CS continued beyond five seconds. Such new learning could modify the motivating capacity which there is evidence CS continuation had acquired. Thus, 12 out of the 14 animals in the CS-continuation group, having made the CR, when subjected to CS continuation frequently crossed back to the side whence they had just come; in some cases, two or more times in succession. Further evidence is

found in Haruki's experiment (4). The CS, in extinction, continued beyond the CS-US interval of acquisition, four seconds, even if no CR had been made. The significant difference in favour of the CS-continuation procedure with regard to the number of trials required to reach the selected extinction criterion of no response within 60 seconds of CS onset, also obtained with regard to the number of trials required to reach the criterion of no response within the CS-US interval, but more trials were required to reach the former criterion. The use of this procedure of continuing the CS beyond the CS-US interval of acquisition, since it exploits the acquired motivational capacity of CS continuation, could, in part, help to explain the considerable resistance to extinction encountered by some investigators such as Solomon, Wynne and their associates.

The strains results contrast with the prediction, on a prevalent view of the part played by fear as an intervening variable in avoidance learning, that the reactive animals, by constitution more emotional, learn to avoid more rapidly and extinguish more slowly. A difference in learning ability might be invoked to explain the opposite results obtained, but the strains have been shown not to be different on the Hebb-Williams test of intelligence (3). The difference in extinction is taken to be dependent on the difference in acquisition and a reflection of the latter. From a consideration of the several measures of acquisition it is suggested that the difference in emotionality may influence the amount of reinforcement derived from an avoidance. There was no significant difference in the number of trials to the first avoidance (Table 2). After the first avoidance, the number of avoidances to the acquisition criterion did not differ significantly, whereas the number of US did. The ratio of the number of avoidances to the acquisition criterion to the number of US after the first avoidance was also significantly different. This would seem to mean that for a reactive animal a given number of avoidances was less reinforcing than for a nonreactive animal, so that the former was likely to experience more shock trials than the latter in reaching the acquisition criterion. Perhaps the differential reinforcement on avoidance trials depends on the different extent to which the emotional state persists in the two strains on avoidance trials.

E. SUMMARY

Two parameters of avoidance learning were examined, one of extinction, termination v. continuation of the CS; and one both of acquisition and extinction, namely, emotional reactivity of rats as determined by selective breeding on the basis of the amount of defecation in the open-field test. Continu-

ance of the CS produced significantly more rapid extinction as predicted. Reasons for the superior efficacy of this procedure were suggested. The significant strain differences in acquisition and extinction were in the opposite direction to expectation based on the assumption of fear as an intervening variable. Lesser reinforcement on avoidance trials due to greater persistence of the emotional state was suggested as accounting for the slower acquisition and more rapid extinction of the avoidance CR in the reactive strain.

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MOST AND LEAST USED PLAY THERAPY LIMITS*

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A. INTRODUCTION AND PURPOSE

All child therapists use limits in play therapy. Generally the limits pertain to physical aggression against the therapist or the equipment, socially unacceptable behavior, safety and health, playroom routines, and physical affection. It would be of interest to know which limits are considered useful by all therapists and which by few therapists.

B. METHOD

Answers to a questionnaire on limits were received from 227 play therapists (100 psychoanalytic, 41 nondirective, and 86 adherents of other schools). The therapists indicated whether or not they regularly used the following limits in play therapy with emotionally disturbed children aged three to 10 years:

1. Taking home a playroom toy
2. Taking home a painting he made
3. Taking home an object he made of clay, etc.
4. Refusing to enter the playroom
5. Leaving the playroom at will
6. Turning off the lights for a long while
7. Pouring a generous amount of water in sand box
8. Spilling sand any place in the room
9. Spilling as much sand as he wants
10. Painting inexpensive toys
11. Painting expensive toys
12. Painting or marking walls or doors
13. Painting or marking furniture
14. Prolonging his stay at the end of the session
15. Bringing a friend
16. Bringing drinks or food to the playroom
17. Lighting matches brought with him
18. Smoking
19. Starting small fires
20. Reading books he brought with him

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21. Doing his school work
22. Breaking inexpensive toys
23. Breaking expensive toys
24. Damaging furniture and fixtures
25. Breaking windows
26. Opening door or window and talking to passers-by
27. Using terms such as Nigger, Mick, Kike, etc.
28. Verbalizing profanities in the playroom
29. Yelling profanities at passers-by
30. Writing four-letter words on blackboard
31. Drawing, painting, or making obscene objects
32. Painting his face
33. Painting his clothes
34. Exploding a whole roll of caps at once
35. Climbing on window sills high above the ground
36. Hitting you mildly
37. Squirting water on you
38. Painting your clothes
39. Throwing sand at your shoes
40. Throwing sand at your person
41. Throwing rubber objects around the room
42. Throwing hard objects around the room
43. Tying you up playfully
44. Shooting suction-tip darts at you
45. Attacking you with some force
46. Sitting on your lap
47. Hugging you for long periods of time
48. Kissing you
49. Fondling you
50. Completely undressing
51. Masturbating openly
52. Drinking polluted water
53. Eating mud, chalk, or fingerpaints
54. Urinating or defecating on the floor

C. RESULTS AND DISCUSSION

Table 1 shows the percentage of therapists of each of the three orientations using particular limits.

The most used play therapy limits pertained to protection of playroom property, child's safety, and the therapist's attire. Over 90 per cent of all therapists regularly set limits on breaking windows, drinking dirty water, and painting the therapist's clothing. Over 80 per cent of all therapists prohibited the child from yelling profanities at passers-by, and over 70 per cent prohibited him from forcefully attacking the therapist and painting walls and doors.

TABLE 1
THE PERCENTAGE OF THERAPISTS OF THREE ORIENTATIONS USING PARTICULAR LIMITS

%	Limit Number and Therapeutic Approach																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
0-10		X	PA													PA		
11-20			ND OT	ND						PA ND								
21-30				PA OT		X	PA ND			OT						ND OT		
31-40					PA ND OT		OT								ND		X	
41-50								X	X									
51-60											PA OT				PA OT			ND
61-70	PA ND										ND		PA	PA				PA OT
71-80	OT											X	ND OT	ND OT				
81-90																		
00I-16																		

Note: PA = Psychoanalysts, ND = Nondirectivists, OT = Others, X = The Three Approaches.

Breaking furniture and fixtures was prohibited by more than 90 per cent of analytic and "other" therapists and by over 80 per cent of nondirectivists. Urinating and defecating in the playroom and climbing on high window sills was prohibited by more than 80 per cent of "other" therapists and by over 70 per cent of nondirective and psychoanalytic therapists.

The least used limits pertained to symbolic expression of socially unacceptable behavior and to playroom routines. Only 10 per cent or less of all therapists set limits on using racial slurs, on speaking profanities, writing four-letter words, drawing or making obscene objects, throwing rubber toys in the room, and taking home paintings made there.

Twenty per cent or less of all therapists prohibited the child from painting his face. Taking home clay objects was prohibited by 10 per cent or less of the psychoanalytic therapists and by 20 per cent or less of the nondirectivists and "others." Bringing food into the playroom was prohibited by 10 per cent or less of the psychoanalytic therapists and by 30 per cent or less of the nondirectivists and "others."

Reading books in the playroom was prohibited by only 10 per cent or less of the psychoanalytic and nondirective therapists and by 20 per cent or less of the "others." Allowing the child to sit on the therapist's lap was prohibited by 10 per cent or less of the nondirectivists and "others" and by 20 per cent or less of the psychoanalytic therapists.

A child's refusal to enter the playroom was honored by many therapists. Only 20 per cent or less of the nondirectivists and 30 per cent of the psychoanalysts and "other" therapists invoked a limit requiring the child's entrance. Painting inexpensive toys was prohibited by 20 per cent or less of the psychoanalytic and nondirective therapists and by 30 per cent or less of the "others."

D. SUMMARY AND CONCLUSIONS

Responses to a questionnaire on limits from 227 play therapists revealed that the most widely used limits pertained to protection of playroom property (breaking windows, furniture, and fixtures and painting walls or doors), child's safety (drinking dirty water and climbing on high sills), therapist's safety (attacking the therapist or painting his clothing), and socially unacceptable behavior (urinating and defecating on the floor and yelling profanities at passers-by).

The least used limits pertained to symbolic expressions of socially unacceptable behavior (racial slurs, speaking or writing profanities, and making obscene objects), and to playroom routines (bringing food to and reading books in the playroom and taking home paintings or clay objects made there).

Most therapists also allowed the child to throw rubber toys, paint his own face, and sit on their laps.

Two patterns emerge clearly from this study:

1. Child therapists show great permissiveness in some areas that are prohibited in society at large. They allow children to verbalize profanities, to write four-letter words on the blackboard, to draw, paint, and make obscene objects, and to use racial slurs. Aware of society's attitude, therapists do not allow children to yell profanities at passers-by.

2. Blatant physical aggression is not tolerated in the playroom. Children are not allowed to destroy costly furnishings and ruin equipment or physically to attack the therapist.

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CHANGE IN MOTOR ACTIVITY AS REINFORCEMENT IN RATS, CHICKS, AND FISH*¹

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A. PROBLEM

Many experimental investigations in recent years have emphasized the importance of so-called nonhomeostatic reinforcers. Nonhomeostatic reinforcements are consequences which strengthen behavioral reactions without supposedly influencing the physiological homeostasis of the organism concerned.

Perhaps the earliest experiment of this kind was performed by Warden and associates (11) when the maternal drive in rats was measured by the obstruction method. Female rats were allowed to cross an electric grid to get to their young. An incentive of this type induced the animals to cross the grid more often within a specified time period than thirsty rats had crossed for water, hungry rats for food, and nondeprived animals for exploratory purposes. Girdner (4) used the onset of a small dim light as reinforcement for bar pressing. Essentially the same kind of experiment with like results was performed by Marx, Henderson, and Roberts (8). These authors suggested that a stimulus change or novelty factor may be working in reinforcements of a nonhomeostatic nature. Other studies which showed nonhomeostatic reinforcements at work were those completed by Butler and Harlow (3) with monkeys working for reinforcement consisting of visual exploration alone; Harlow and McClearn (7) with monkeys solving discrimination problems without apparent primary reward; by Myers and Miller (10) with rats learning brightness discrimination; and by Butler (2) with monkeys learning to push a lever to hear and view other monkeys, or to see or hear an electric train positioned outside the experimental cage.

It seemed to the authors of this paper that the assumption of stimulus change first proposed by Marx, Henderson, and Roberts describes the basic nature of these types of motivated activities adequately, and furthermore would seem to cover a much wider range of activities than hitherto imagined. To

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test this hypothesis, a number of pilot studies were performed. In one such study, nondeprived rats were run in a runway, terminating in a five-finger goal box. It was reasoned that if the animals acted according to chance, they should enter each goal box approximately the same number of times during a large number of runs. The animals did not act according to chance, but showed clearly a preference for entering the extreme arms of the five-finger goal box. This was interpreted to mean that perhaps change in motor activity may be the motivating agent. As a follow-up study on this problem, a small dim lightsource was now placed in the compartment of the maze which had been entered least during the previous experiment. The purpose of this study was to compare motor versus sensory change. Again the extreme arms were entered most frequently, but the arm with the light increased in entries to more than twice its previous attained frequency. Following this, an experiment was designed to show that motor change may be produced by pre-disposing the animal to make certain turns before reaching the final choice point. From these studies, the following conclusions, based upon rigid statistical requirements, were drawn. (a) Rats will seek motor change according to the kinds of experiences in motor activities they had before reaching a choice point; and (b) this phenomenon does not seem to be conditioned by sequence effects. The problem at hand was to design a study which would show whether or not this phenomenon held true over a range of species along the phylogenetic scale. To this end, the following investigation was conducted.

B. METHOD

1. *Subjects*

Four male adult albino Wistar rats, four three-day-old baby chicks, and four goldfish were used as subjects.

2. *Apparatus*

The apparatus consisted of a straight runway, four times the length of the animal, and five finger-like protrusions, extending outward from a common choice point, two times the body length of the animal. The protrusions were at angles of 90, 45, and 0 degrees to the runway. The mazes for the rats and chicks were constructed from wood and covered with hardware cloth. The fish maze was made from hardware cloth and placed into a container of water. See Figure 1.

3. *Procedure*

The animals were placed singly into the respective apparatus and run 10 times daily for five days. An entry into the end compartment was counted

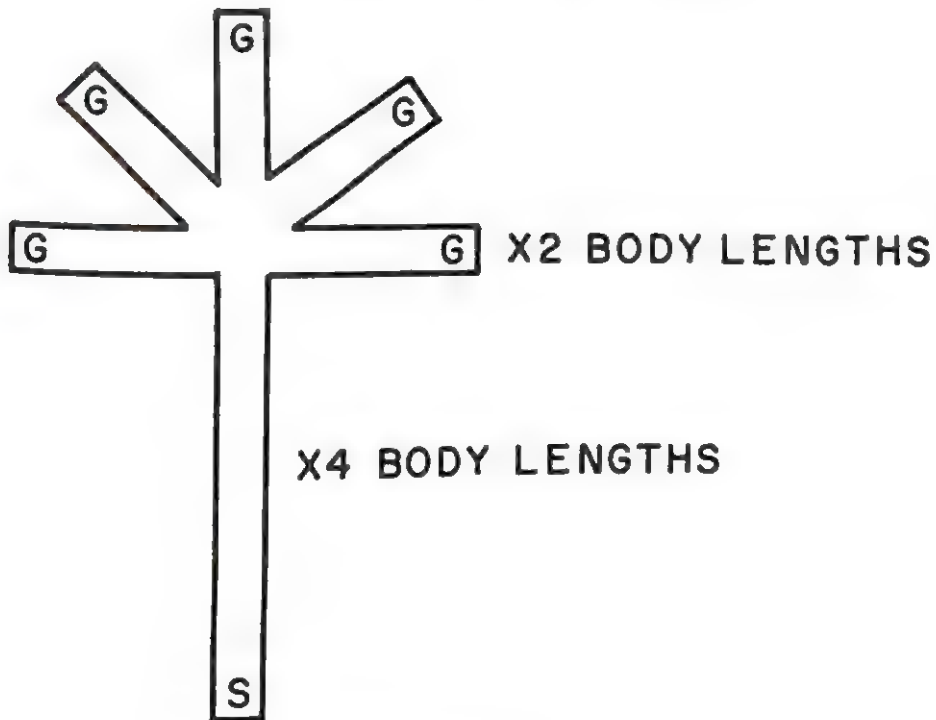


FIGURE 1
EXPERIMENTAL MAZE
(S denotes starting compartment, G denotes goal compartment)

when the animal entered the respective goal box with more than half of its body. After that the animal was taken from that compartment and placed into the starting box for another run, until the 10 daily runs were completed. All parts of the apparatus were as much alike as possible, and great care was taken to treat all animals alike while removing and replacing them in the apparatus.

C. RESULTS

The results can be seen in Table 1. In all animals there was observed a definite tendency toward change of motor activity after running or swimming down the straight runway. Chi squares were computed for the three groups of animals. For the rat data, a Chi square of 20.35 for 4 *dfs* was found, which showed statistical significance beyond the .001 level. For the chicks the Chi square was 27.75 for 4 *dfs* which also was significant at the .001 level. The Chi square for the fish was 34.10 for 4 *dfs*, again satisfying statistical requirements at the .001 level.

TABLE 1
EXPERIMENTAL RESULTS

Animals	Left-Left	Entries made in the maze			Right-Right	Chi-squares
		Left	Middle	Right		
Rats	54	24	31	35	56	20.35***
Chicks	45	36	18	37	64	27.75***
Fish	51	23	53	17	56	34.10***
Chance expectancy	40	40	40	40	40	

*** Significant at the .001 level or better.

D. DISCUSSION

What does this mean? If the animals had reacted according to chance expectancy they should have entered each one of the goal boxes approximately an equal number of times. The animals did not do so. Since there was no apparent differential sensory stimulation present in any of the goal boxes, and since homeostatic motivation was clearly ruled out, the authors concluded that this evidence suggested the presence of nonhomeostatic motivation, probably derived from the motivational aspects of changing proprioceptive and perhaps vestibular cues. This seemed to be in accord with findings of other investigators who were not exactly concerned with the same problem, but nevertheless found similar results. One such study, performed by Montgomery and Segall (9) resulted in a black-white discrimination when a one-minute run in a Dashiell maze was offered as differential reinforcement in a simple T-maze. The results of this investigation agreed in principle also with results obtained by Grosslight and Ticknor (6) and Grosslight and Harrison (5), although the theoretical implications are treated somewhat differently here.

It seemed from the findings of this study, the pilot studies cited earlier, and from implications by other investigators that the common element in experimental situations controlled by some kind of reinforcement is a changing pattern of stimuli. This study shows that this holds true over at least part of the phylogenetic scale. Grosslight's studies and common sense suggest that this phenomenon may be more or less universal. Changing patterns of stimuli are an integral part of human experiences also. The best demonstration of this principle in the realm of human behavior came from a study by Bexton, Heron, and Scott (1). When human volunteers were placed in an environment which greatly restricted sensory input and motor activities, hallucinations occurred. The organism attempted to supply the change which was lacking in the environment.

E. SUMMARY

This study attempted to show that change in motor activity is nonrandom and predictable over at least part of the phylogenetic scale.

Four rats, chicks, and fish were run in a maze consisting of a straight runway and five finger-like end-compartments, arranged at 90, 45 and 0 degree angles to the runway.

The results met statistical criteria at the .001 level in all instances and indicated that animals seemingly are motivated by a change in motor activities.

These results were interpreted in the light of the stimulus-change hypothesis first proposed by Marx, Henderson, and Roberts (8).

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SITUATIONAL FACTORS IN THE LATERAL PREFERENCE OF RHESUS MONKEYS*¹

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A. INTRODUCTION

When a bilaterally symmetrical organism is stimulated symmetrically, but responds with one side of its body more than 75 per cent of the time, we may say the organism has a lateral preference. Explanations of this familiar phenomenon have been many and varied, but they share one common feature. They all assume that an observed response asymmetry can be related to either an innate or an acquired asymmetry of function and/or structure *within* the organism. Those investigators who, like Chamberlain (1), prefer an innate-functional kind of explanation usually refer to "cerebral dominance," while those who prefer an innate-structural explanation, like Cole and Glees (2), search for anatomic asymmetries such as unequal bifurcation of the pyramids. Still other investigators emphasize the fact that lateral preferences may be acquired. There are functionalists, such as Warren (7), who have demonstrated changes in the proportion of animals shifting lateral preference as a function of practice, and structuralists, such as Peterson and Chaplin (5), who have investigated the effects of central nervous system lesions on learned lateral preferences or transfer of preferences.

The purpose of the present study was to emphasize the importance of an obvious, but previously unexplored source of variation in lateral preferences. More specifically, our data demonstrate the dependence of lateral preferences on certain *extra-organismic* conditions.

B. METHOD AND RESULTS

The subjects were 15 mature rhesus monkeys, all of which had had extensive previous training on discrimination problems. The subjects were tested in the Emory modification (6) of the Wisconsin General Test Ap-

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paratus (WGTA) (3) and in a two-compartment cage. All of the tests described below involved some manipulation of objects with either or both hands, and each response was rewarded with a bit of high preference food such as a raisin. On each trial the hand(s) used by the subject was recorded.

1. *Test I: Simple Reach*

In the first test, food was visible to the subject in either the right or left food well of the test tray of the WGTA. The position of the food was varied randomly from trial to trial until 12 trials had been presented on each side. The subject's task was simply to reach out with either hand, pick up the food, and draw it in. The proportion of right-hand responses was determined for each animal under each condition of the test (i.e., food on the subject's right, and food on the subject's left). A subject's Preference Index (*PI*) represents the empirically derived probability of a response using the right hand under a given set of conditions. Figure 1(A) shows the normalized frequency distributions of *PI* under the two conditions for the 15 subjects. These distributions are slightly bimodal, U shaped, and roughly similar to one another. The mean *PI*s are indicated by arrows.

2. *Test II: String*

In the next two tests an attempt was made to produce situations requiring additional manipulative skills. In Test II the animal was placed in the WGTA and presented with a test tray to which a string was secured. A raisin was attached to the end of the string, which extended toward the subject. Twelve trials were given in which the string was on the right and on the left, and 25 trials were given with the string in the center position. The animal's task was to reach out, free the food from the end of the string, and retrieve it. Figure 1(B) shows the distributions of *PI* obtained. The distributions are all roughly U shaped and only a small shift in mean *PI* accompanied the changes in position of the string. Apparently this task was not as difficult as anticipated, requiring little manipulative skill, and being essentially equivalent to Test I.

3. *Test III: Wire*

Test III was a one-handed test of increased difficulty. The animal was placed in the WGTA and presented with a stiff horizontal wire, about 12 inches long, secured in the middle by a clamp. A "Life Saver" was slipped over the end of the wire on either the right or the left side. The subject's task differed in one important respect from those previously described. In

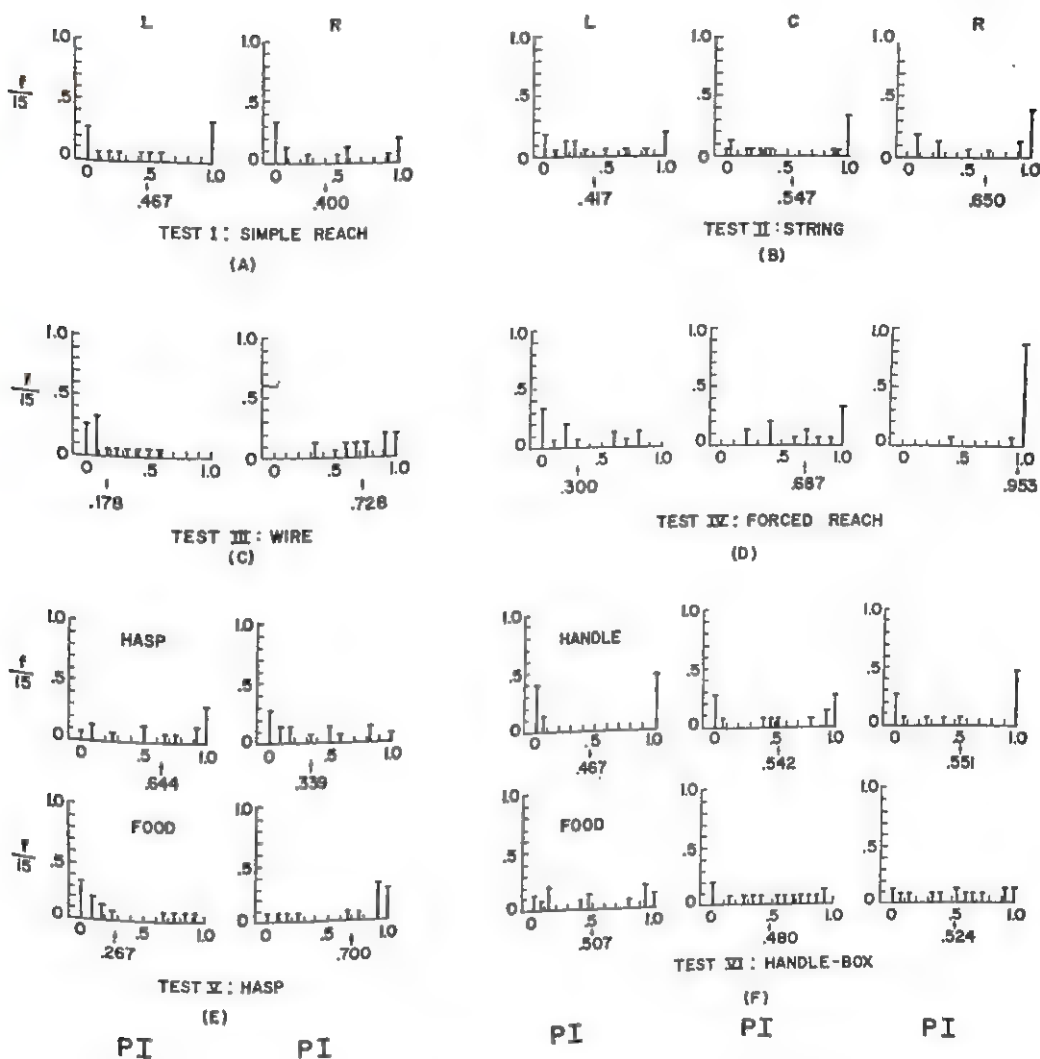


FIGURE 1
PROPORTION OF ANIMALS AS A FUNCTION OF PREFERENCE INDEX (PI) UNDER THE
CONDITIONS IMPOSED BY SIX HANDEDNESS TESTS

order to secure the candy, the subject had to slide the Life Saver along the wire about six inches laterally instead of pulling it in directly. Twelve trials were given with the Life Saver in each position. Figure 1(C) shows the distributions of PI obtained. These distributions are J shaped and oppositely skewed, with a large difference between mean PIs. This result suggests that

the direction of hand movement required plays a role in the determination of hand preference.

4. *Test IV: Forced Reach*

The fourth test, unlike the previous three, placed severe restrictions on body orientation, but required little manipulative skill. The animals were tested in a two-compartment cage arranged in such a way that the dividing partition could be removed. The subject was placed in one side of the cage and offered a raisin held in the experimenter's hand. The bars on the front of the cage were arranged in such a way that the animal had to reach through the openings between a few bars near the wall of the cage formed by the partition. Each animal was given 10 trials in the left-hand cage with the opening to the animal's left and 10 trials in the right-hand cage with the opening to the animal's right. The partition was then removed and 10 unbiased trials were given. Figure 1(D) shows the distributions of *PI* under these conditions. It may be seen that the biased distributions are J shaped and skewed in opposite directions, while the unbiased distribution, if not U shaped, is roughly rectangular. Thus a subject's unbiased *PI* may be either raised or lowered by the application of an external bias which renders a response to one side or the other more difficult to perform by restricting body orientation.

5. *Test V: Hasp*

The fifth and sixth tests differed from the four tests previously described by requiring the use of both hands to secure the food reward. However, they placed no restrictions on body orientation. In the fifth test the subject was placed in the WGTA and presented with a hasp which extended over one of two food wells on either side of the midline. The animal was required to lift the hasp in order to secure the food. If the animal released the hasp in an attempt to use the same hand to secure the food, the hasp fell closed. Each animal was given 12 trials under the two conditions. The hand used to lift the hasp, and the hand used to secure the food were recorded. Figure 1(E) shows the distributions of *PI* obtained. The top two distributions represent the hand used to lift the hasp and the bottom two represent the hand used to secure the reward. All these distributions are J shaped. It is clear that when the hasp covered the food well on the animal's left, the right hand was usually preferred to lift the hasp, while the left hand was usually used to secure the reward. When the hasp was on the animal's right, the mean *PI*s were reversed. In this way the animal avoided crossing one hand over the other. It would thus appear that a number of situational factors may interact to determine lateral preference when complexly related hand movements are

to be performed in the absence of restriction on body orientation. In the present situation position and direction of movement were important.

6. *Test VI: Handle-Box*

The sixth test was similar to the one just described. The animal was placed in the WGTA and offered a small box with an extended handle. The box was presented in the middle of the test tray, and on the left and right, with the handle toward the subject. Each animal was given 15 trials with the box in each position. The animal's task was to grasp the handle, draw in the box, and then reach inside for the reward. Both the hand used to grasp the handle, and the hand used to secure the food, were recorded. Figure 1(F) shows the distributions of *PI* obtained. The top three distributions show the hand used to grasp the handle, and the bottom three show the hand used to secure the food. Although no large shifts in mean *PI* seem to result from changes in the position of the box, it may be noted that while many animals showed a strong preference for either the right or left hand when grasping the handle, fewer animals showed strong preferences with regard to the hand used to secure the food. This indicates that not all animals used both hands in this situation.

7. *Significance Tests*

In order to determine the effectiveness of the biases imposed by the six tests described, a *t* was computed for the difference between R and L mean handedness scores for each test. The only *ts* which failed to reach significance were those computed for the hand used in Test I and both parts of Test VI. The direction of the difference in mean *PI* in Test I is unexpected; however, the difference is not reliable. A subsequent test of the animals resulted in the predicted direction of difference in mean *PI*, but again this difference was not significant. (The negative *t* obtained on Test V was to be expected.) All but one of the five remaining *ts* were significant beyond the .01 level. All *ts* are presented in the lower margin of Table 1.

To evaluate the effect of the biases on individual animals, a binomial index of dispersion (4) was computed for each animal on each test. A significant value of the index indicates that an animal's *PIs* under the conditions of the test were probably not drawn from the same binomial distribution, i.e., that a significant shift in hand preference occurred. Table 1 shows the obtained distribution of chi squares over subjects and tests. Inspection of the rows in Table 1 shows that some animals—e.g., 43—made more significant shifts in *PI* than others—e.g., 49 and 50—and suggests variation

TABLE 1
BINOMIAL INDICES OF DISPERSION OVER SUBJECTS AND TESTS, MEAN *PI* OVER ALL TESTS FOR EACH SUBJECT, AND *T*s FOR EACH TEST
(Lower entry in each cell gives *df*)

Sub.	Test								\overline{PI} s
	I: Simple Reach	II: String	III: Wire	IV: Forced Reach	V: Hasp Hasp	Food	VI: Handle-Box Handle	Food	
2	0.00 1	0.00 2	4.20* 1	30.00** 2	0.00 1	1.04 1	0.00 2	2.14 2	.893
42	3.43 1	.28 2	8.71** 1	19.23** 2	5.04* 1	2.18 1	16.56** 2	6.58* 2	.349
43	6.32* 1	24.00** 2	46.10** 1	4.29 2	4.20* 1	8.71** 1	8.00* 2	9.83** 2	.595
48	1.04 1	2.06 2	20.31** 1	15.60** 2	1.71 1	24.00** 1	0.00 2	7.17* 2	.706
49	0.00 1	.94 2	2.27 1	14.07** 2	1.04 1	3.43 1	2.05 2	4.19 2	.266
50	.17 1	0.00 2	1.67 1	9.23** 2	.89 1	2.27 1	2.05 2	2.46 2	.707
51	1.04 1	2.18 2	9.88** 1	6.67* 2	0.00 1	0.00 1	0.00 2	1.05 2	.321
55	.38 1	14.40** 2	4.44* 1	16.80** 2	1.20 1	20.31** 1	12.60** 2	1.35 2	.397
57	2.74 1	2.25 2	.69 1	11.10** 2	8.00** 1	1.71 1	0.00 2	5.83 2	.548
58	.17 1	6.04* 2	6.75** 1	6.24* 2	3.56 1	.25 1	6.43* 2	2.20 2	.667
62	1.04 1	4.24 2	9.52** 1	21.82** 2	20.31** 1	1.67 1	.18 2	6.43* 2	.540
64	0.00 1	2.06 2	8.00** 1	20.36** 2	1.04 1	.38 1	0.00 2	0.00 2	.099
65	0.00 1	2.25 2	20.31** 1	5.00 2	8.00** 1	10.97** 1	0.00 2	.73 2	.635
66	0.00 1	9.00* 2	24.00** 1	20.36** 2	2.18 1	3.43 1	2.05 2	2.05 2	.679
68	0.00 1	3.94 2	.75 1	117.50** 2	3.00 1	1.67 1	0.00 2	8.08* 2	.206
<i>t</i>	-1.70	2.67*	6.53**	8.37**	-3.90**	4.30**	1.88	0.28	
<i>df</i>	14	14	14	14	14	14	14	14	

* Significant at .05 level.

** Significant at .01 level.

in susceptibility of the animals to the imposed biases. It was hypothesized that the susceptibility of an animal, as measured by the number of significant shifts in PI , would be negatively correlated with its "degree" of hand preference, as measured by the deviation of an average PI over all tests and conditions from .5. The mean PI s over all tests and conditions for each subject are tabulated in the column headed \overline{PI} s in Table 1. A trend did appear in the predicted direction, but the rank difference correlation coefficient computed ($\rho = -.38$, $P < .1$) failed to reach significance.

C. SUMMARY AND CONCLUSIONS

The purpose of this study was to demonstrate that lateral preferences in the rhesus monkey depend in part on certain extra-organismic biases which tend to restrict responses to one side or the other.

Fifteen rhesus monkeys, all of which had undergone extensive discrimination learning were observed on six multiple trial tests involving simple manipulation of objects to secure food reward. The hand(s) used on each trial was recorded. The tests included obtaining food from a tray, the end of a string, the experimenter's hand, and a horizontal wire. Another test required the animals to lift a hasp which covered the reward, and the last involved drawing in a box by its handle and removing the food within it. Each test included biased trials, randomly sequenced, on which presentation of the food was to the monkey's right or left.

The proportion of right hand responses (Preference Index, PI) was determined for each animal under each condition (L, C, R) of each test. Significant differences between mean PI s under the left and right conditions were obtained in all but three cases, and it was concluded that external biases of the types used generally influence hand preferences in rhesus monkeys. Two additional conclusions appear warranted: (a) distributions of PI tend to be U shaped in the absence of bias, and (b) in its presence these distributions usually become J shaped and reflect its direction. Finally, a small negative correlation (although not significant) was found between a measure of each animal's susceptibility to bias and degree of hand preference.

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THE EFFECTS OF INFANTILE STIMULATION ON EMOTIONALITY AND HOARDING IN RATS*¹

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A. INTRODUCTION AND PURPOSE

The investigation to be reported was designed to test two hypotheses, (a) that quite different responses may be interpreted as manifestations of an enduring disposition to be emotional, and (b) that the strength of the disposition to emotionality in adult rats varies with the amount of infantile stimulation.

The basis for both of these hypotheses is empirical. Handled young rats have been found to be less emotional as adults than nonhandled rats in separate studies by Bernstein (1) and Hunt and Otis (6). Denenberg (4) found a curvilinear relationship between number of days of handling during infancy and acquisition of an avoidance habit in adulthood. An intermediate amount of handling was related to better performance in adulthood than was too little or too much handling. The latter results can be interpreted with the model offered by Spence (8) as showing that intermediate degrees of the model produce nonemotional adult rats. In an apparently unrelated area of study, Bindra (2) found that "shy" rats hoard less than "nonshy" rats. He argues that the onset of hoarding is in some way a function of the degree of security of the animals in the hoarding situation.

If the above studies are reliable, one might expect that the amount of infantile handling would affect the degree of emotionality in the adult rat and that the degree of emotionality would affect the amount of hoarding. This hypothesis can be tested by measuring the emotionality of groups of animals subjected to different amounts of infantile stimulation. The expectation would be that a group receiving an intermediate degree of infantile stimulation would show less shyness and timidity, less frequent defecation, and more ambulation or exploration in an open field test. Furthermore, since the

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amount of hoarding may be primarily a function of the emotionality of the animal in the open runway situation, it would be expected that the less emotional rats would start hoarding sooner and would hoard more than emotional rats. Should these expectations be supported by the evidence, the resulting nomological network would help establish construct validity for the concept, "emotionality" (3).

B. METHOD

1. *Subjects*

The Ss were 24 newborn black hooded rats from the Michigan colony. From birth to the 17th day of age, all the pups remained with the bitch in the mating cages and were never handled. On the 17th day of life, the pups were weaned and their sex determined.

They were placed in individual cages which were marked with the rat's name and group number. The rat's group was determined by a random split-litter technique which equated each group for sex.

2. *Apparatus*

a. Hoarding apparatus. The hoarding apparatus consisted of a basic alley, a board seven feet long supported at a height of four feet by a road-horse type of underpinning. The board was six inches wide. The home cage was placed at one end, and the food bin (6" by 6" by 2" in size) was situated at the other end. Two such apparatuses were placed in the same well-lit experimental room in which the temperature ranged from 75 to 80 degrees Fahrenheit. Six inches from the nearest edge of the food bin was a line which served as a criterion for the timidity test; this line was at a distance of 55 inches from the edge of the home cage.

b. Open field apparatus. The open field consisted of a large wooden box (30" by 30" by 12" in size) placed in a well-lit experimental room. The floor was a hard washable surface and was marked off in five-inch squares. A 100-watt electric light was hung so that the bulb was centered two feet above the floor of the apparatus. A metronome, placed alongside the open field, served as a masking noise, beating 200 times per minute. Because the metronome had an inadequate spring, it was quiet for approximately the last 30 seconds of each 10-minute trial.

3. *Experimental Conditions*

From the 18th day of age to the 80th day of age, the control animals ($N = 8$) were left in their individual cages and were never handled or re-

moved from their cages. Pups from a second group ($N = 8$) were removed from their cages and gentled for 10 minutes a day for a period of 10 days beginning at 18 days of age. The handling consisted of stroking the animals and allowing them freedom to move from one hand to the other. From the 28th day until the 80th day, the rats in this group were treated identically to the control animals. Animals in a third group ($N = 8$) were each removed from their cages and gentled for 10 minutes a day for a period of 20 days beginning at age 18 days. From the 38th to the 80th day of age, these rats were treated the same as the control rats.

4. *Behavioral Measures in Adulthood*

a. Shyness, timidity, and hoarding. Measures were obtained from the 84th through the 89th days in the life of each rat. During this period a 23-hour food deprivation schedule that began on the 80th day was maintained. All the tests were conducted following 23 hours of food privation.

Each rat's home cage was placed on the open, elevated runway that was part of the hoarding apparatus. The home cage remained on the hoarding apparatus, with the door to the cage open and facing the runway, for a period of 30 minutes on each of six successive nights. The animals were run after 6:00 P.M. in order to take advantage of their natural activity cycle.

b. Shyness. Latency of emergence (0 to 180 minutes) from the home cage on to the hoarding runway was obtained as the index of shyness. The criterion of emergence was that all four of the rat's feet must rest on the hoarding runway outside the home cage. If a rat did not emerge at all during the six test periods (i.e., on the six 30-minute tests), it received the maximum score of 180 minutes.

c. Timidity. A criterion line was drawn on the runway six inches from the food bin and 55 inches from the open door of the home cage. The latency of crossing this line with all four feet was the index of timidity. Like shyness, the maximum score possible for this test was 180 minutes.

d. Case emergences. It seemed likely that counting the number of emergences during the first two 30-minute trials would be useful as an index of the disposition to emotionality, and that this measure would correlate negatively with the shyness and timidity scores, and that it would correlate positively with ambulation in the open field and with number of pellets hoarded. The first two days were selected since this is the time period when the situation is most unfamiliar to all animals.

e. Hoarding. At the conclusion of each 30-minute test period, the number of pellets hoarded was recorded and the pellets were taken away from the

animals. Each rat received three pellets immediately after the conclusion of each trial. Each animal was run three times on each of the two hoarding runways during the six test periods.

f. Open field test. At approximately 95 days of age, each rat was given one trial of 10-minutes duration in the open field apparatus. Each five-inch square which was marked off on the floor of this apparatus was considered a "unit" in determining ambulation scores. The number of units entered and the number of excretions were recorded by *E* and an assistant. A correlation of .997 was obtained between the records of the two scorers.

C. RESULTS

The data obtained from the method described support the hypothesis that the amount of infantile stimulation affects each of the test-measures in the fashion hypothesized. They also support the hypothesis that each of these test-measures can be interpreted as manifestations of a general disposition toward emotionality.

1. *Test of Shyness*

Comparisons between the Control, 10-day- and 20-day-gentled groups in mean latency of emergence from the home cage on to the hoarding runway are presented in Table 1. The *F* test indicates that differences between groups are statistically significant ($F = 6.01, P < .01$). A *t* test, employing the estimate of error obtained from the analysis of variance with 21 *df* (5) shows that the Control group is significantly more shy than the 20-day-gentled group ($t = 2.92, P < .01$). Although the 10-day-gentled animals are lower in mean latency (i.e., less shy) than the 20-day-gentled animals, the difference is not significant ($t = .17$).

2. *Number of Emergences*

A median test shows that there are differences between groups ($\chi^2 = 6.48, df = 2, P < .05$). Six of the 20-day-gentled animals emerged more than the median number of times (median = 3) while seven of the Control rats emerged less than the median number of times. Although the 10-day-gentled rats showed a greater number of emergences overall, they were equally often above and below the median.

3. *Test of Timidity*

The differences between groups on the Timidity measure (i.e., mean latency of reaching the end of the hoarding runway) are presented in Table

TABLE 1

SHYNESS TEST: NUMBER OF MINUTES (TO NEAREST MINUTE) BEFORE FIRST EMERGENCE FROM THE HOME CAGE ON TO THE HOARDING RUNWAY

	Control (<i>N</i> = 8)	10-day- gentled (<i>N</i> = 8)	20-day- gentled (<i>N</i> = 8)	<i>df</i>	Mean Square	<i>F</i>	<i>t</i>	<i>P</i>
<i>M</i>	128.75	37.37	42.50					
<i>SD</i>	61.11	59.15	57.40					
Analysis of Variance								
Components								
Between groups				2	31087.5	6.01		
Within groups				21	3511.3			
$(P < .01 \text{ when } F = 5.58 \text{ with 2 and 21 } df)$								
Differences								
Control > 20-day-gentled							2.92	.01
20-day-gentled > 10-day-gentled							.17	ns

2. No control rat ventured as far as the criterion point. Consequently, the mean latency of the Control group is the maximum of 180 minutes. The zero variation precluded the use of an analysis of variance. Running *t* tests with heterogeneous variances between the Control and Gentled groups required a reduction in the degrees of freedom from 14 to 6 (5). Nevertheless, the differences between gentled and control animals is very striking. The Control group is more timid than both the 10-day-gentled ($t = 4.11$, $P < .01$) and 20-day-gentled ($t = 4.07$, $P < .01$) groups. As in the case of the measure of shyness, the 20-day-gentled rats are more timid than the 10-day-gentled rats, but again the difference is not statistically significant.

TABLE 2

TIMIDITY TEST: NUMBER OF MINUTES (TO NEAREST MINUTE) TO REACH THE END OF THE HOARDING RUNWAY FURTHEST FROM THE HOME CAGE

	Control (<i>N</i> = 8)	10-day-gentled (<i>N</i> = 8)	20-day-gentled (<i>N</i> = 8)	<i>t</i>	<i>df</i>	<i>P</i>
<i>M</i>	180.00	81.75	93.25			
<i>SD</i>	0.00	67.61	67.27			
Differences						
Control > 10-day-gentled				4.11	7	.01
Control > 20-day-gentled				4.07	7	.01
20-day-gentled > 10-day-gentled				.34	14	ns

4. Hoarding

Since the distribution of scores indicating the number of pellets hoarded was badly skewed, a logarithmic transformation of raw scores was made prior to the statistical analysis (7). The transformation procedure involved adding one to the raw score, finding the log and multiplying by ten. The resultant scores are referred to as deci-log units. The mean deci-log units of pellets hoarded and the comparison *t* tests are shown in Table 3.

TABLE 3
DECI-LOG UNITS OF PELLETS HOARDED DURING SIX 30-MINUTE TRIALS

	Control (<i>N</i> = 8)	10-day-gentled (<i>N</i> = 8)	20-day-gentled (<i>N</i> = 8)	<i>t</i>	<i>df</i>	<i>P</i>
<i>M</i>	0.00	11.55	9.73			
<i>SD</i>	0.00	8.84	5.53			
Differences						
10-day-gentled > Control				3.69	7	.01
20-day-gentled > Control				4.96	7	.01
10-day-gentled > 20-day-gentled				.49	14	ns

Both the 10-day- and 20-day-gentled groups hoarded significantly more pellets than did the control animals ($P < .01$). The 10-day-gentled rats hoarded more than twice as many pellets in raw score units as the 20-day-gentled animals, but the difference between these groups does not approach an acceptable level of statistical significance.

5. Defecation and Urination

The 10-day-gentled rats tended to defecate and urinate less than the Control and 20-day-gentled rats both on the hoarding apparatus and in the open field, but none of the differences between groups is significant on these measures (either singly or when combined).

6. Ambulation in Open Field

In Table 4 the summary of the ambulation scores (i.e., mean number of units entered within a 10-minute period) and the analysis of variance are presented. The 10-day-gentled rats entered a significantly greater number of units than the Control rats ($t = 2.48$, $P < .05$). As with every other behavioral index of emotionality within the study, the 20-day-gentled rats showed an indication that they have stronger disposition to emotionality on the average than the 10-day-gentled rats by the fact that they move around

less in the open field. However, the t test fails again to show a reliable difference between these groups.

All but five of the correlations shown in Table 5 are statistically significant ($P < .05$) and all 15 are in the directions specified by hypotheses. Correlations between Emergences during the first two trials, Shyness, Timidity, and

TABLE 4
AMBULATION SCORE: NUMBER OF UNITS ENTERED IN THE OPEN FIELD DURING ONE 10-MINUTE TRIAL

	Control ($N = 8$)	10-day- gentled ($N = 8$)	20-day- gentled ($N = 8$)	df	Mean Square	F	t	P
M	121.00	228.88	211.63					
SD	82.83	103.32	72.31					
Analysis of Variance								
Components								
Between groups				2	26863.20	3.54		
Within groups				21	7587.96			
$(P < .05$ when $F = 3.49$ with 2 and 21 df)								
Differences							2.48	.05
10-day-gentled > Control							.40	ns
10-day-gentled > 20-day-gentled							2.33	.05
20-day-gentled > Control								

Hoarding are inflated because these measures were obtained on the same apparatus during the same test trials. If an animal never emerges from his home cage, his Emergence score would be zero, his Shyness score would be a maximum 180, his Timidity score would be 180 as well, and his Hoarding score would be 0. However, few of the scores for Emergences were zero. As a consequence, the correlations between Emergences on the one hand and Shyness, Timidity, and Hoarding on the other were less than 1.00, namely $-.50$, $-.73$, and $.71$. Furthermore, the correlations between Shyness, Timidity, and Hoarding were also less than 1.00, $.66$, $-.65$, and $-.88$.

The significant positive correlations between Ambulation and Hoarding ($r = .52$, $P < .01$), Ambulation and Emergences ($r = .30$, $P < .05$), and the negative correlations between Ambulation and measures of Shyness ($r = -.45$, $P < .01$), Timidity ($r = -.52$, $P < .01$), and Excretions ($r = -.34$, $P < .05$) clearly indicate that the high correlation coefficients between partially dependent measures are not entirely artifactual.

D. DISCUSSION

Once it has been established that various adult responses can be interpreted to be manifestations of a single generalized disposition toward emotionality,

TABLE 5
INTERCORRELATIONS BETWEEN MEASURES OF EMOTIONALITY AND HOARDING ($N = 24$)^a

	Timidity	Ambulation	Emergences	Hoarding	Excretions
Shyness	.66	— .52	— .44	— .62	.05
Timidity		— .54	— .70	— .75	.33
Ambulation			.19	.56	— .24
Emergences				.60	— .42
Hoarding					— .33

^a In this matrix of correlations, the frequency of excretions counted during the test periods on the hoarding apparatus and in the open field were combined. Theoretically all of the excretions occurred in unfamiliar situations and, therefore, can be combined.

Note: $P < .05$ when $r = .35$ and $P < .01$ when $r = .49$, one-tail test.

one can then speak more confidently of a trait like *emotionality* being related to antecedent infantile experiences. Thus far the claim that infantile experience alters emotionality is based upon studies in which only one or two adult responses have served as the behavioral indicators of the trait termed *emotionality*. This study was suggested in part by the inference that if the various indicators which have been considered to indicate emotionality in various investigations are reproducible with a given sample of subjects, the intercorrelations among these indicators should be significant and the sign of the correlations should be specifiable. The results of this study clearly support the inference (shyness, timidity, excretions in strange situations, number of cage emergences on to a hoarding runway over two 30-minute trials, number of pellets hoarded on an open and elevated runway, and ambulation in the open field). The results are interpreted as supporting this hypothesis. The significant correlations among all these dependent variables, except for several low relationships between excretions and the other measures, are consistent with the view that one underlying factor influences all of these behaviors.

A second hypothesis which guided the design of the present study was that different degrees of handling during infancy are determinants of varied strengths of the disposition to emotionality in adulthood. It was found that both groups of animals which were gentled in infancy displayed less emotionality than control animals as measured by the shyness, timidity, and open field criteria, and that the gentled rats also hoarded more pellets on an open and elevated runway as adults. These results are interpreted as showing that too little stimulation in infancy, as represented by the control rats, is associated with a relatively strong disposition to emotionality in the adult rat, and that this disposition is an important determinant of whether or not (and how much) a rat will hoard.

E. SUMMARY

The hypotheses guiding this research were:

1. The disposition to emotionality is manifested under certain conditions in a variety of different kinds of adult behaviors.
2. The disposition to emotionality is related causally to infantile experience of various degrees of gentling.

Three groups of infant rats were (*a*) rats not handled at all ($N = 8$), (*b*) rats gentled for 10 days beginning at age 17 days ($N = 8$), and (*c*) rats gentled for 20 days beginning at age 17 days ($N = 8$).

The results show that both groups of gentled rats hoarded more and displayed less emotionality as adults than control rats. Though none of the differences were significant, the 20-day-gentled animals show a trend on all the measures obtained that they are more emotional than the 10-day-gentled rats.

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NONINTELLECTUAL FACTORS ASSOCIATED WITH PERFORMANCE IN MEDICAL SCHOOL*¹

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A. PROBLEM

The ever-increasing expenditure of time and money involved in training physicians has made it incumbent upon medical schools to try to select only those applicants with the greatest promise of academic success. Various selection devices have been utilized in attempts to predict academic success such as premedical grades (5, 28), interest tests (2, 18, 29), aptitude tests (6, 22), and intelligence tests (20, 30). However, the relatively low predictive ability of these instruments as well as studies which have emphasized the large number of medical students who experience emotional difficulties (12, 23) have focused interest on assessing the role of nonintellectual factors in academic performance (1, 4, 8, 16, 19).

The most widely used clinical test has been the MMPI (6, 9, 10, 11, 17, 25, 26, 27). Although Schofield (27) found that students with marked deviation on the Hy, Pd or Sc scales performed less satisfactorily than students with profiles containing nondeviant scores, the MMPI has not consistently proved able to predict achievement or differentiate between medical students and normal college males. The principal finding (9, 10) has been that underachievers showed a general tendency toward a relatively unsophisticated denial of personal weaknesses, as measured by the MMPI L scale, while students who work to capacity tend to manifest a more realistic self-appraisal.

The relative lack of consistent empirical discrimination between successful and unsuccessful medical students suggests a need for further work attempting to delineate personality factors which influence performance. A possible reason for the paucity of clear-cut results has been the use of psychological instruments not designed for answering questions about nonpsychiatric populations. The Edwards Personal Preference Schedule (EPPS) (3) was

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designed to measure needs of normal individuals. The only EPPS study of medical students was carried out by Schlag (24) who found that medical students had higher needs for nurturance (i.e., helping others) and endurance and a lower need for succorance (i.e., being helped by others) than a normative group of college students. Another test, the Interpersonal Check List (ICL) (13) appears to be well designed for investigating self and ideal concepts. For example, McDonald (17) showed that freshman medical students describe themselves as competitive, managerial persons, whereas many of their ideals involved aggressive or passive personality descriptions.

To determine nonintellectual correlates of performance in medical school, the following comparisons seem pertinent: (a) needs of medical students *vs* needs of a comparable nonmedical student group, (b) self and ideal descriptions of medical students *vs* similar ratings by a nonmedical group of students, (c) successful *vs* unsuccessful medical students' patterns of response to the EPPS and ICL, (d) overachievers' *vs* underachievers' patterns of response to the same two tests, and (e) successful *vs* unsuccessful students of above average ability and successful *vs* unsuccessful students of below average ability on the two tests.

B. METHOD

1. Subjects

The subjects for this study consisted of a class of 66 medical students at the Medical College of South Carolina. The ages of these 63 male and three female students as freshmen ranged from 18 to 29 with a mean age of 23.5 years. On admission, 26 of the students were married while 40 class members were single (including the three female students). Eight members of the original class of 80 were lost through attrition or transfer and six other members were deleted from the study due to machine scoring failure (which accounts for the different total *Ns* in tables based on different tests).

2. Instruments

The EPPS (3) is a 225-item test which measures 15 relatively independent normal need variables (e.g., achievement, aggression, heterosexuality) drawn from a list of manifest needs described by Murray (21) and is so constructed that responding in the socially approved direction is minimized.

The ICL is currently used in the Interpersonal System of Personality (14, 15) to measure two different levels of behavior: conscious self-description

and description of others (Level II) and a description of the ideal (Level V). This test consists of 128 items (e.g., forceful, usually gives in, considerate, sarcastic) with 16 items for each of eight interpersonal variables (i.e., octants). The octants, in the usual order, are 1, managerial-autocratic; 2, competitive-narcissistic; 3, blunt-aggressive; 4, skeptical-distrustful; 5, self-effacing-masochistic; 6, docile-dependent; 7, cooperative-overconventional; and 8, responsible-overgenerous.

The ICL raw data are converted to Dominance and Love scores which are obtained by solving the following equations: $Dom = (1 - 5) + 0.7 (8 + 2 - 4 - 6)$ and $Lov = (7 - 3) + 0.7 (8 - 2 - 4 + 6)$, in which the numbers refer to octants and the number of items the subject checks for each octant are substituted in the equation. To illustrate, if a subject checks eight Octant 1 items, three Octant 5 items, ten Octant 8 items, seven Octant 2 items, three Octant 4 items, and one Octant 6 item, the appropriate formula for Dom would be $(8 - 3) + 0.7 (10 + 7 - 3 - 1)$, the solution of which would yield a raw score of 14.1. Raw scores may be positive or negative and vary through a wide range (-38.4 to $+38.4$).

Relationships between the different ratings (i.e., self, spouse, ideal, etc.) are called variability indices and reflect the amount of dissimilarity between the ratings. The index which describes the relationship between self and ideal (ratings used in the present study) is called "self-acceptance" if there is a discrepancy of one octant or less between these ratings, while the term "self-rejection" is used to indicate a discrepancy of more than one octant between these two measures.

The students' class rankings based on cumulative grade averages for the freshman and sophomore years were furnished by the Registrar's office. Scores on the Medical College Admission Tests (MCAT), a standard battery of aptitude tests employed nationally in selecting medical students, were also available. This battery consists of four separate tests: Verbal Ability, Quantitative, Modern Science, and Medical Science.

3. Procedure

The administration of the EPPS occurred prior to admission as part of a nationwide appraisal of medical school applicants by the American Association of Medical Colleges. The ICL was administered during the freshman year in connection with a separate study (17). Each student was asked to describe himself as well as his ideal on this form. In describing an ideal, the students were instructed not to choose an admired family member or friend, but a generalized ideal. A standardized technique was followed for dealing

with any questions that students might raise about the instructions contained in the test booklets or the purpose of these tests.

Combination of each student's class standing with the ranked scores for his four MCAT aptitude tests allowed placement of some of the students into subgroups: (a) those doing well academically who also achieved high scores on the aptitude tests (HH), (b) those doing poorly academically who also obtained low scores on the aptitude tests (LL), (c) those with high aptitude scores but poor academic records—"underachievers" (UA), and (d) those with low aptitude scores but good academic records—"overachievers" (OA). The criterion for "high" class standing for the HH subgroup was that the student be ranked in the highest quarter of the class. The criterion for "low" class standing for the LL subgroup was that the student be ranked in the lowest quarter of the class. However, application of the same criteria to the UA and OA subgroups resulted in insufficient *N*s, so for these subgroups "low" and "high" were defined as the lower and upper halves of the class. For all subgroups, *S*s were categorized as "high" on the aptitude tests if three of the four subtest scores fell in the upper half of the distribution and "low" if not more than one subtest score fell in the upper half of the distribution. Slightly over half the members of the class did not fit the combined criteria and could not be included in these groups.

Mean scores for Dominance (Dom) and Love (Lov) factors on both self and ideal ratings were obtained for all subjects. To determine differences between groups, the diagnostic circle was divided into octants 2187 *vs* 3456, a standard cut which combines the idealized "virtues" of strength, responsibility and conventionality *vs* the more "neurotic" factors of dependence, submission, distrust, and anger. Another standard cut—Octants 234 (hostility) *vs* Octants 678 (friendliness)—was also used.

C. RESULTS AND DISCUSSION

The results of this study are presented in a series of tables. Examination of Table 1, which compares mean EPPS need scores for our group and Edwards' normative sample of college males, reveals that the medical student group differs markedly in some respects from male college students. Medical students, for example, possess significantly higher scores for need Endurance ($t = 4.73$, $p < .01$) a finding which is consistent with Schlag's observation (24) for a similar group of freshmen medical students. Lower scores for medical students were observed for needs Change and Autonomy ($t = 4.00$ and 7.73 respectively; $p < .01$ in both cases) and Affiliation ($t = 2.10$, $p < .05$). The interpretation of these findings is that medical students are

TABLE 1
COMPARISON OF MEANS OF EPPS VARIABLES FOR COLLEGE MALES AND MEDICAL SCHOOL CLASS^a

Variable	Mean	
	College	Medical
1. Achievement	15.66	15.34
2. Deference	11.21	11.61
3. Order	10.23	11.10
4. Exhibitionism	14.40	14.81
5. Autonomy	14.34	11.10**
6. Affiliation	15.00	14.00*
7. Intraception	16.21	16.93
8. Succorance	10.74	10.53
9. Dominance	17.44	16.66
10. Abasement	12.24	13.00
11. Nurturance	14.04	15.19
12. Change	15.51	13.10**
13. Endurance	12.66	16.00**
14. Heterosexuality	17.65	18.17
15. Aggression	12.79	12.31
Consistency score	11.53	11.20
N	760	66

^a The three female students were retained for this analysis as their mean need scores did not differ from those of the men.

* $p < .05$.

** $p < .01$.

more concerned with being persistent and working hard and less concerned with being independent and unconventional, doing new and different things, and making many friends than other males of similar age and education. The greater than usual need for a persistent, hard working approach seems to fit the realities of the medical school situation quite well, but the relatively low need for independence does not appear to coincide with the physician's omniscient, omnipotent public image.

The only available normative ICL data (7) consists of self ratings of 100 subjects consisting of graduate students, clinical pastoral trainees, and students in college extension courses. Examination of Table 2 reveals little difference between these two groups' self-descriptions as the majority of both groups describe themselves as leaders and competitors (Octants 1 and 2). However, three times as many medical students describe themselves as hostile (Octant 3). While no Ideal ratings are available for Gynther's sample, it is interesting to note that almost two-thirds (62 per cent) of the medical students indicated that they would like to act in what Leary has described as a "neurotic" manner (Octants 3, 4, 5 or 6). The most desired Ideal is to be a critical-sadistic person (23 per cent). The next most frequent ideals are to be competitive-narcissistic (20 per cent) and self-effacing-masochistic (16

TABLE 2
COMPARISON OF SELF-RATINGS (IN PER CENT) OF MEDICAL STUDENTS (MS) AND NON-MEDICAL STUDENTS (NMS); IDEAL RATINGS OF MEDICAL STUDENTS

Octant	Interpersonal variable	MS	Self NMS	Ideal
1	Managerial-autocratic	30	41	4
2	Competitive-narcissistic	30	25	20
3	Blunt-aggressive	14	3	23
4	Skeptical-distrustful	3	3	9
5	Self-effacing-masochistic	3	3	16
6	Docile-dependent	2	3	14
7	Cooperative-overconventional	4	7	4
8	Responsible-overgenerous	14	15	9
	<i>N</i>	66	100	66

per cent). Fifty-six per cent of these students are "self-rejectors" (i.e., self-ratings differ significantly from ideal ratings), thus indicating their dissatisfaction with their present interpersonal behavior.

The findings reported above are essentially normative. Now we will turn to a consideration of intragroup analyses. With regard to the ICL self-ratings, about half of the students who ranked in the top half of the class described themselves as "friendly" (Octants 6, 7 or 8) while nearly all of the poorer students described themselves as "hostile" persons (Octants 2, 3 or 4) ($\chi^2 = 14.30$, $p < .001$). A similar comparison between these groups' ideal ratings approached significance ($\chi^2 = 4.56$, $.05 < p < .10$).

The better students also differ significantly from the poorer students in their needs. These superior students obtained lower mean need scores for both intraception ($t = 2.08$, $p < .05$) and abasement ($t = 2.76$, $p < .01$). This may suggest that successful students focus on their patients' symptomatology, not underlying motivational structure, and tend not to accept blame for therapeutic failures; the less successful students, on the other hand, tend to become more personally involved with their patients and feel guilty if treatment does not bring about a successful outcome.

Table 3 presents the mean scores for the ICL self and ideal Dom and Lov variables for the four groups divided on the basis of achievement. There were no significant differences between any of these groups on Dom and Lov scores for the self-ratings. However, both the overachievers and the underachievers indicated that ideally they would like to be more dominant than the unsuccessful poor students ($t = 4.00$ and 4.80 , respectively; $p < .01$ in both cases). The underachievers' tendency to be concerned with dominant behavior (which includes achievement) may indicate that they are much more anxious to do better work than their performance would indicate. A later

TABLE 3
MEAN STANDARD SCORES ON DOMINANCE (DOM) AND LOVE (LOV) DIMENSION FOR SUCCESSFUL SUPERIOR STUDENTS (HH), UNSUCCESSFUL INFERIOR STUDENTS (LL), OVERACHIEVERS (OA), AND UNDERACHIEVERS (UA)

Group	N	Self		Ideal	
		Dom	Lov	Dom	Lov
HH	7	57.14	47.14	57.00	44.86
OA	7	58.86	51.86	65.30	54.30
UA	8	56.63	47.88	67.00	44.13
LL	8	56.63	48.25	47.36	46.63

study could profit from obtaining measures of anxiety levels of these different classes of students. Another finding is the overachievers' desire to be more friendly than the underachievers ($t = 3.41, p < .02$). A possible interpretation is that the overachievers do not find that high class standing, which necessitates a disproportionate amount of effort on their part, compensates for their relative lack of friends.

Table 4 pertains to need differences between these same four groups. As the major interest of this study is to relate nonintellectual factors to performance, the principal comparisons will be those which hold level of ability relatively constant and allow for varied performance. For this purpose, a comparison of the need scores of the HH group and the UA group, both of which scored above average on the Medical College Admission Tests (MCAT), is appropriate. Statistical analyses show that the HH group has

TABLE 4
MEAN EPPS NEED SCORES FOR SUCCESSFUL SUPERIOR STUDENTS (HH), UNSUCCESSFUL INFERIOR STUDENTS (LL), OVERACHIEVERS (OA), AND UNDERACHIEVERS (UA)

Variable	HH	OA	UA	LL
1. Achievement	17.30	15.00	14.83	16.25
2. Deference	11.30	12.50	14.66	11.00
3. Order	11.57	11.66	10.00	10.75
4. Exhibitionism	15.00	17.00	14.33	13.13
5. Autonomy	13.30	10.83	12.00	11.23
6. Affiliation	15.30	13.17	14.83	13.00
7. Intraception	12.85	17.50	18.00	19.63
8. Succorance	13.71	10.00	9.50	7.25
9. Dominance	15.14	16.50	16.00	18.50
10. Abasement	11.17	13.33	13.33	11.88
11. Nurture	14.00	13.33	13.33	14.75
12. Change	14.14	11.66	17.33	13.25
13. Endurance	11.85	16.17	16.50	16.25
14. Heterosexuality	12.57	18.84	14.66	20.13
15. Aggression	21.27	15.66	10.66	13.13
Consistency score	10.85	10.17	10.50	11.88
N	12.56	6	6	8
	7			

a significantly greater need for achievement ($t = 2.37$, $p < .05$), whereas the underachievers have a significantly greater need for deference ($t = 7.75$, $p < .01$) and for change ($t = 2.30$, $p < .05$). These results seem to indicate that individuals who need frequent novel experiences, as well as people to make decisions for them, are not likely to do well in medical school despite good native ability. The other pertinent comparison is between mean need scores of the OA and the LL groups, both of which scored below average on the MCAT. Here the only difference which approached significance was on exhibitionism which the OA group scored higher on ($t = 1.82$, $.05 < p < .10$). Thus, a desire to be the center of attention and have personal accomplishments to talk about may motivate those with relatively poor native ability to "outdo" themselves.

D. SUMMARY AND CONCLUSIONS

The principal aim of this investigation was to determine nonintellectual factors related to good and poor performance in medical school by means of the Edwards Personal Preference Schedule and the Interpersonal Check List, tests which were devised to study "normal" needs and modes of behavior. Subjects for this study were 66 medical students whose Medical College Admission Tests scores and class rankings based on cumulative grade averages for the freshman and sophomore years were also available.

Comparison of medical students' EPPS need scores with those of college male students revealed significantly higher scores for medical students on need Endurance as well as lower scores for needs Autonomy and Affiliation. ICL self-ratings of these students were quite similar with those of a normative group, although two-thirds of the medical students indicated that they would like to act in a more "neurotic" manner.

Practically all the students who ranked in the bottom half of the class described themselves as self-centered, hostile or distrustful, whereas only one-half of the better students described themselves in those terms. The better students also obtained lower mean need Intraception and Abasement scores. Both over- and underachievers indicated their desire to be more dominant than the unsuccessful poor students. Students with above average ability who were performing satisfactorily differed from those performing less well in their higher scores on need Achievement and lower scores on needs Deference and Change. The only difference observed between poor students with below average ability and those with similar ability but performing above expectations was the latter group's tendency for higher scores on need Exhibitionism.

In conclusion, it appears that selection committees should proceed with

caution in admitting applicants to medical schools who describe themselves as self-centered, hostile, or distrustful, especially if these individuals also seem inclined to blame themselves excessively for failure and habitually analyze their own and others' behavior for "underlying" motives. Applicants who can accept routine, are less dependent upon others, are achievement oriented, and describe themselves as friendly, responsible persons are more likely to perform successfully in medical schools.

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VARIABLE REWARDS AND PERIPHERAL CUES IN
DISCRIMINATIONS BY IRRADIATED AND
NONIRRADIATED MONKEYS*¹

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ROGER T. DAVIS AND WILLIAM E. LOVELACE

A. INTRODUCTION

Brown, Carr, and Overall (1) reported that nonirradiated monkeys associated peripherally placed stimuli with stimuli that were available for problem solving, and monkeys that had survived large doses of whole-body radiation (WBR) with mixed source of radiation did not. The authors interpreted their results as indicating that the response threshold of irradiated *Ss* is displaced and their attention is narrowed. Because earlier work has shown that an increase in either drive or incentive increases the frequency of responses that are directed toward the reward [Cotton (3); Davis, Settlege, and Harlow (5)], the present *Es* concluded that the results obtained by Brown, Carr, and Overall were related to the difference in preference for raisin rewards between irradiated and nonirradiated monkeys (4). This conclusion was especially tenable since Brown, Carr, and Overall (1) employed subjects in their experiment that were survivors of the earlier study by Davis (4) which showed that raisins are preferred more by irradiated than nonirradiated monkeys, and celery is preferred less by irradiated than nonirradiated monkeys.

The present study was designed to determine if the effect that was reported by Brown, Carr, and Overall was related to changes in preferences of irradiated and nonirradiated monkeys for foods. Raisin and celery were selected as rewards, and it was hypothesized that a strong incentive (raisin) would cause the animals to attend to the problem at hand and ignore peripheral cues, whereas a weak incentive would favor *Ss*' use of peripheral cues. Also, if groups of *Ss* differ in their preference for the incentives, this should be reflected in the ability of *Ss* to use peripheral cues.

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B. METHODS

1. *Subjects*

Fourteen rhesus monkeys were used as *Ss*. Nine were aged approximately 10.5 to 11.5 years at the beginning of the experiment. Four of these nine had survived three large doses of whole-body irradiation which were given six, seven, and eight years prior to the present study and which totaled 1100 r. Five *Ss* were nonirradiated controls that received training that was nearly comparable to that received by the irradiated *Ss*, and the remaining five *Ss* were progeny of the older *Ss* and were aged 3.0 to 5.0 years. The young *Ss* had a different training history than the old *Ss*, but had extensive training on discrimination problems (Cochrane and Davis, 2).

2. *Apparatus*

Training was conducted in the WGTA. The stimuli, procedures, and criteria were modeled after those of Brown, Carr, and Overall (1). The foodwells of the stimulus tray were 14 inches apart, center-to-center, and 3.0 inches from the front of the tray. Eight dissimilar pairs of common use and manufactured objects were painted red and employed during the first 16 days of the experiment. Four dissimilar pairs of planometric stimuli, consisting of randomly selected magazine pictures glued on 2.0-by-2.0-inch squares of Masonite were used as stimuli during the last eight days of the experiment.

3. *Procedure*

Each *S* received two problems a day for 24 days. The first problem consisted of discriminating between the stimuli, A and B. Six inches behind these stimuli were two additional stimuli, A' and B'. Food was placed in the left- or right-hand foodwell according to a predetermined random order, and the position of the A object followed the position of the food. The A' and B' objects were placed approximately 6.0 inches behind the position of the A and B objects respectively. A small piece of celery or one raisin constituted two different conditions of reinforcement and one of these conditions was presented during four-day periods of time in a CRRC order. The second problem that was given each day involved removing objects A and B from the tray, placing objects A' and B' over the two foodwells and rewarding the A' object on each trial. The same set of stimuli was used each day during a four-day period and different sets of stimuli were used in each subsequent four-day period. Subjects were trained on both problems each day until they either: (a) made 10 consecutive correct responses, (b) had five consecutive balks, or (c) completed

150 trials. A balk was indicated when an *S* responded to neither stimulus during 45 seconds on a particular trial.

C. RESULTS AND DISCUSSION

The median percentage of errors required by *Ss* in the three groups to reach the criterion of learning Problems 1 and 2 under celery and raisin rewards is shown in Figure 1. The filled circles represent the performance of the old irradiated *Ss*, the open circles the old nonirradiated *Ss*, and the squares the young nonirradiated *Ss*.

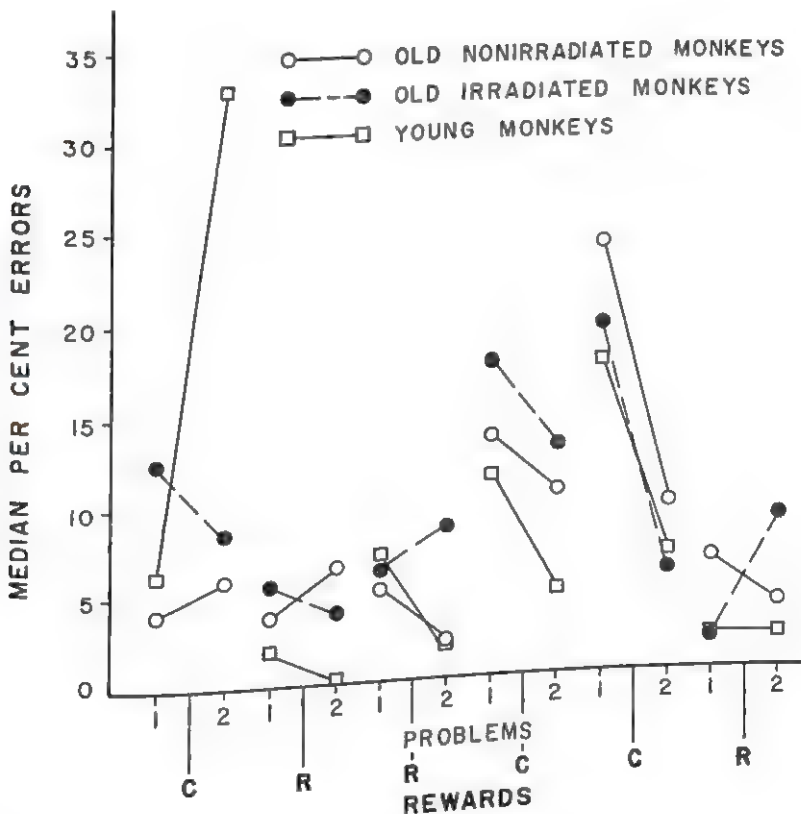


FIGURE 1
PERFORMANCE OF OLD IRRADIATED, OLD NONIRRADIATED, AND YOUNG NONIRRADIATED MONKEYS ON DISCRIMINATION PROBLEMS AS A FUNCTION OF INCENTIVE AND PERIPHERAL CUES

The letters C and R on the abscissa represent conditions of celery and raisin rewards respectively. The first and second problems given each day are designated by the numbers 1 and 2.

There were three obvious and significant effects. One of these occurred with raisin rewards and was the tendency for irradiated *Ss* to do less well on the second problem than on the first. This was the effect that Brown, Carr, and Overall (1) reported under the same condition of reward. In the present study the presence of this effect was determined by taking the difference between Problems 1 and 2 for each *S*, adding a constant to each score to eliminate negative numbers, and ranking the 14 resulting numbers. All of the old irradiated *Ss* and three of the 10 remaining *Ss* performed less well on the second than on the first problem under raisin reward, and a comparison of the ranks of the amount of this decrement indicated that the old irradiated *Ss* were significantly more likely to do worse on the second than on the first problem than were the remaining *Ss* ($U = 5$, $p = .05$, $n_1 = 4$, $n_2 = 10$). The effect was also characteristic and significant during the second and third, but not during the first time the condition using raisins was presented.

More striking than the above effect was the effect produced by giving two different incentives. Every *S* made a higher percentage of errors under celery than under raisin reward. Also, the Brown-Carr-Overall effect disappeared under celery reward and there was a decline in errors between the first and second problems with celery rewards. This decline occurred among all of the nine old *Ss* ($p < .01$ using the sign test), but for only two of the young *Ss*. Furthermore, the difference between young and old *Ss* is significant if the difference between Problems 1 and 2 is obtained for each *S*, a constant is added to each score, and the derived scores ranked ($U = 5$, $p = .02$, $n_1 = 5$, $n_2 = 9$). The high number of errors on Problem 1, and the sharp drop in errors under celery reward on Problem 2 to a level of performance comparable to that obtained under raisin reward, indicates that *Ss* do not attend to the stimulus as well under weak as under strong incentive. The *Ss* observe peripheral cues, including those provided by the second set of objects, during the time they are solving Problem 1. When Problem 2 is presented, *Ss* perform efficiently, in spite of poor attention to the reward, because of the associations that were formed during the learning of the first problem.

D. CONCLUSIONS

Brown, Carr, and Overall reported that irradiated *Ss* were unable to discriminate peripheral cues, and this was corroborated by the findings of the present study. However, the effect disappears under a weak incentive. This supports the hypothesis that differences in food preferences of irradiated and nonirradiated monkeys explain the phenomenon of a narrowing of attention to stimuli.

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MONKEYS' FEAR OF SNAKES: A STUDY OF ITS BASIS AND GENERALITY*

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A. INTRODUCTION

An examination of the psychological literature dealing with emotional behavior makes it apparent that fear responses are regarded to be extremely important aspects of adaptive and nonadaptive behavior. A moderate arousal of fear or increase in level of activation brought about by various objects and events may facilitate adaptive behavior by serving as a valuable guide for the organism's safety, while intense or chronic fear may lead to maladaptive behavior. Although there seems to be general agreement concerning the importance of fear as a major determinant of adjustment, theorists differ considerably in their emphasis on the role of innate and maturational factors as opposed to individual learning experiences and social stimulation in the development, organization, and dynamics of fear.

The elicitation of traumatic fear in human subjects and subhuman primates by snakes has received considerable attention in the literature. The primates' fear of snakes has been explained in a variety of ways ranging from the assumption that fear of snakes is a specific, inborn or innate reaction, to the opposing assumption that this fear is entirely acquired or learned through individual experience.

At one extreme, Berlyne (2) states with respect to the strength of fear as a specific innate stimulus-response association that "stimuli having the power to release instinctive responses will dominate indifferent stimuli." Likewise Masserman and Pechtel (11) cite the ethologists' interpretation of fear in terms of "innate responses" to "social releasers" as a preferred theoretical explanation of the monkey's fear of snakes. At the other extreme, Yerkes and Yerkes (19) conclude from their research findings with chimpanzees that there is no basis for specific fear responses in primates other than "... individual experience with a given type of object." Between these two extreme theoretical positions a wide range of views and experimental findings are to be found.

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Although recent advances in amplifiers, oscillographs and recording systems have been utilized for the recording of autonomic and somatic changes during fear arousal, the complexity of the neural, autonomic, and endocrine interactions has thus far precluded the development of any single representative measure of bodily changes characteristic of specific fear reactions. Consequently at the behavioral level, various postural orientations, highly focalized or sustained attention, facial expressions, gestures, alarm vocalizations, excretions, and escape-avoidance responses have been used as external indications of fear arousal. Among the major experimental variables, which prior research has indicated as being relevant for the elicitation or maintenance of fear and escape-avoidance behavior in primates, are the following: (a) novelty of the stimulus; (b) specific stimulus qualities such as movement, size, shape, color and sound; (c) method of presentation of stimuli; (d) age of subject; (e) individual differences between subjects which may be independent of prior experiences with any given stimulus; (f) prior individual experience with a noxious or aversive stimulus; (g) social influences; and (h) specific innate or unconditioned fear of a given object, class of objects or object quality.

1. *Novelty of Stimulus*

A novel stimulus will often produce general excitement and sometimes fear in primates. Harlow (6) reports that infant monkeys will show fear when placed in a strange situation with strange objects. Innocuous objects will terrify the infants, as demonstrated by their clinging to a surrogate mother. Even a minor change in a familiar situation can, however, produce excitement and fear in infant monkeys (5). On the other hand, Tinklepaugh and Hartman (15) report that a live garter snake failed to elicit fear in two infant monkeys who were with their mothers. Haslerud (7) states that chimpanzees react to almost any new object with caution and often with fear, and that caution is more persistent in older chimps. Valentine (16), in his well-known paper reporting observations on his own children, concludes that novelty, while relevant to the arousal of fear, is neither a necessary nor a sufficient condition for fear. Welker (17, 18), in his studies of the play of chimpanzees, noted that novelty of objects elicited timidity in the chimps; more so in younger than in older animals. There was some relation between the relative novelty of the object and the amount of caution exhibited toward it. However, an opposite effect was observed, since novel stimuli also evoked more play and exploration. As objects increased in familiarity, the responsiveness of the chimps (both contacts and withdrawals) tended to decrease. Dolin,

Zborovskaia and Zamakhover (4) made essentially the same observation with monkeys and apes. They report three phases of response to initially novel objects: the first an "inhibitory" reaction; the second, one of active exploration, which might last up to an hour; and a third, an alternation of exploration with periods of passive staring in a *trance-like state*. Both Welker and Dolin *et al.* report individual differences in their subjects' reactions to various test objects.

2. Other Stimulus Characteristics

Various other stimulus qualities have been shown to be relevant to the production of fear in primates. Most important among these stimulus qualities is movement. Thus Yerkes and Yerkes conclude that "visual movement, intensity, abruptness, suddenness and rapidity of change in stimulus or stimulus complex" are dominant in producing avoidance responses (19). Even as apparently innocuous an object as a moving white rubber ball can produce screaming and withdrawal in a young chimp (Carlyle *et al.*, 9; McCulloch and Haslerud, 12). Haslerud (7), however, reports that while movement is an important variable for young chimps, there is little if any distinction in the responses of older chimps with respect to animate and inanimate objects. Given conflicting approach-avoidance motives, even an infant monkey may approach an animate stimulus, in this case a rabbit, if it is sufficiently attractive as a contact stimulus (Foley, 5, p. 91).

Size, shape and color of stimulus objects have not all been studied as experimental variables in the evocation of fear, but the work of McCulloch and Haslerud (12) suggests that all may be of some import. Welker (17, 18) used test objects varying in size, shape and color in his study of the effects of novel stimuli. Since novel objects elicited timidity (initial avoidance of contact) and since the above qualities determined, at least in part, the novel character of the object, their relevance to avoidance and perhaps fear is apparent.

3. Method of Presentation

The manner in which stimuli are presented in the test situation may also have some effect on the organism's reactions. Fear-arousing stimuli have been presented behind a glass partition (Masserman and Pechtel, 11), behind a wire screen (Haslerud, 7), inside a box held behind a wire screen (Hebb, 8), and directly into the living cage or test cage (McCulloch and Haslerud, 12; Yerkes and Yerkes, 19; Masserman and Pechtel, 11; Dolin, Zboravskaia and Zamakhover, 4; Jacobsen, Jacobsen and Yoshioka, 9; Foley, 5; Tinklepaugh and Hartman, 15). Comparison of results from these various studies is diffi-

cult since in addition to different methods of presentation, different objects were used and different criteria of fear or timidity were employed.

An object introduced directly into the cage of a monkey can (but does not necessarily) produce a more extreme avoidance reaction than one presented behind a wire-mesh screen. It is also true, however, that closer and more sustained approach responses including manipulation are possible under conditions of direct presentation.

4. *Age of Subjects*

All studies which have used animals covering any substantial age span have produced results indicating that age is a significant factor in fear behavior.

Infant chimpanzees are relatively unresponsive to novel objects, showing relatively little response either positive or negative (Yerkes and Yerkes, 19; Welker, 18), but this may depend in large part upon the manner in which the infant is raised and the situation in which it is tested, since Harlow (6) reports quite different results with infant rhesus monkeys.

Chimpanzee children have been reported as both more responsive (Welker, 17) and as less responsive (Welker, 18; Haslerud, 7) than are adult chimpanzees to novel stimuli. Here again, however, the apparent conflict may be largely a function of test procedures and criteria of responsiveness. The major age effect that does appear to hold up consistently is that older animals are more cautious (or fearful) than are younger animals with respect to inanimate objects. The most tenable explanation of this finding appears to be that offered by Yerkes and Yerkes (19) that inanimate objects may have acquired more significance for older animals. With regard to animate objects, the effectiveness of motion as a fear-provoking stimulus has already been noted.

5. *Individual Differences*

There always exists the possibility of individual differences in personality and temperament among subhuman primates which may affect the individual's response to an object, class of objects, or objects in general. Some subjects tend to be more timid or fearful, while others are more aggressive. In addition, the relative security which any animal feels in the presence of a given experimenter may effect the character, intensity and extent of his fear reaction to any or all objects. However, instinctive fear should still be manifested, even if modified in form, regardless of the relative security of the test situation.

6. *Prior Experience*

The individual organism's prior experience with any given noxious or aversive object or class of objects has been repeatedly indicated as a relevant variable in the previous discussion of fear-motivated behavior. Yerkes and Yerkes (19), Hebb (8), Welker (17, 18), and Haslerud (7) report general preferences and dislikes for certain objects among primates, but also tremendous individual differences. While reptiles are allegedly avoided, some animals do not appear to be particularly disturbed by them. The problem of individual experiences with any type of stimulus object and the importance of such experience in arousal of fear is obviously a central problem in this area.

7. *Social Influence*

For animals who have lived in colonies, whether in a laboratory or in the wild, social influences may also play an important role in fear responses. One animal responding with fear to a given object can alarm and terrorize a whole colony (Antonius, 1; Kohler, 10). The potential effects of such a social experience on the behavior of any individual when again faced with the same or a similar stimulus are apparent.

8. *Innate Fears*

Finally there remains the possibility that primates may have a specific innate fear of certain types of objects such as snakes. While the evidence presented above does not preclude this possibility, it renders such an explanation highly untenable. The reported effects related to stimulus qualities, age of subjects, and possibly even method of presentation could be handled within the framework of an instinct theory of fear, but the reported effects of novelty, individual and social experience, and the individual differences in preference for and reaction to various objects are at variance with such an explanation.

The animal research laboratory at the Cleveland Psychiatric Institute maintains a rhesus colony which appeared particularly well-suited for further investigation of the monkeys' alleged fear of snakes.

The colony contains monkeys ranging in age from two months to nine years, and includes monkeys born and reared in the laboratory and the local zoo, as well as monkeys born and reared in the jungle. It was felt that such a colony would offer a good opportunity to study the effects of environment and past experience as opposed to unconditioned or innate factors on the monkey's reactions to snakes. Specifically it was hypothesized that:

- I. Rhesus monkeys would not differ in their responses to snakes, as com-

pared with other novel stimulus objects when the snake and the other objects were presented under controlled conditions.

II. Specific fear of snakes, if it occurred, would be more likely in jungle-reared monkeys than in zoo- or laboratory-reared monkeys.

In addition to the specific objects and the early environment of the subjects, the following variables were also studied in relation to fear arousal, without any explicit hypotheses being made concerning the direction of their effects: age of subjects, movement of test objects, and method of presentation of test objects.

B. SUBJECTS

The subjects for this study were 14 experimentally naive rhesus monkeys ranging in age from two months to nine years. The animals were housed singly or in pairs. Data concerning age, sex and early environment of each subject are given in Table 1.

TABLE 1
SEX, AGE AND ORIGIN OF EXPERIMENTAL SUBJECTS

Name	Sex	Age at test	Where born	Time in zoo or jungle
Charlie (S-4)	M	2 mo.	Laboratory	—
Susie (S-3)	F	3 mo.	Laboratory	—
Shirley (S-2)	F	22 mo.	Jungle	6 mo.
Norma (S-9)	F	22 mo.	Jungle	6 mo.
Nancy (S-10)	F	22 mo.	Jungle	6 mo.
Matilda (S-14)	F	26 mo.	Jungle	6 mo.
Anne (S-13)	F	26 mo.	Jungle	6 mo.
Juliet (S-11)	F	28 mo.	Laboratory	—
Sarah (S-12)	F	28 mo.	Jungle	6 mo.
Romeo (S-8)	M	30 mo.	Laboratory	—
Pitt (S-1)	F	5½ yr.	Jungle	4 yr.
Susie, Sr. (S-6)	F	8 yr.	Zoo	7 yr.
Buster (S-5)	M	8 yr.	Zoo	7 yr.
Sadie (S-7)	F	9 yr.	Jungle	7 yr.

In addition to the age variable, of considerable importance is the environmental history of these animals. Four of the subjects had been born in the laboratory, separated from their mothers on the first or second postnatal day and raised entirely by humans. Two subjects had been born and raised in a colony at the Cleveland Zoo. The remaining eight subjects had been born and raised in the jungle, six being taken into captivity at around six months of age, and the other two at about four and seven years of age. While the ages

of these jungle-born monkeys are estimates, the experience of the persons making the estimates permits confidence that for the younger animals the estimated ages are accurate to within a few months, and for the older animals, accuracy is probably within one year.

C. APPARATUS

Each subject was tested in an aluminum transport cage $12\frac{1}{2}'' \times 16'' \times 18\frac{1}{2}''$. The cage had sides of expanded metal and each end consisted of a sliding panel, one of which was of clear plastic.

For testing, the cage was placed on a large table and completely enclosed within a large cardboard screen. The area immediately in front of the transparent door was spread with white towels and illuminated from above by a 25-watt bulb. All stimulus objects were presented on the white surface directly under the lamp.

Observations were made through small holes cut in the cardboard enclosure. The observers had a record sheet listing various categories of approach and avoidance behavior, visual fixations and specific signs of fear. Appropriate estimates of frequency and intensity of response were recorded with comments concerning behavior not included on the record sheet.

In addition to this, a quantitative record of total visual fixation time and frequency of visual fixation of each test stimulus was made by means of a micro-switch and an electrically operated counter and stop clock. The approximate percentage of time for approach, no movement, random movement and escape-avoidance movements was also estimated by the observer who operated the counter-clock mechanism.

A comparison of the two types of observations showed no discrepancies in the behavior patterns reported, and since the record sheet gave a fuller account of the subjects' behavior in the test situation, only these data were collected systematically throughout the experiment and used in the analysis.

D. PROCEDURE

Four test objects consisting of a toy rubber cat, a toy snake approximately 15 inches long, a live garter snake 18 inches long, and a live mouse were used. The order of presentation was varied for the different test days, the order for Day 1 being that just mentioned. The subjects were tested for three consecutive days with the stimulus objects outside the cage. On Day 3 following the standard presentation, the objects were also placed inside the cage. All subjects except S-1 were tested on a fourth day, the fourth day testing varying in time from one month to two days from the original series

of three days. In addition, the order of presentation of the objects on Days 1 through 3 was not the same for S-1, as this subject was used in setting up the procedures which were formalized for the other 13 subjects. This subject's behavior showed no apparent deviations as a result of the slight variation in procedure.

Each subject was placed in the transport cage in the test situation for a 30-minute adaptation period before actual testing began. The first test object was then placed in front of the clear plastic panel and a curtain raised so that the object was clearly visible to the subject. Observations of the subject's behavior were made in the following areas: visual exploration—brief, intermittent, sustained; alarm vocalization; evacuation; bodily orientation—approach, no movement, random movement, approach-avoidance, turns head away, withdraws, attempts escape and threatening facial expression, posture, or actual attack. Each object was presented for three minutes, during which time the observers recorded the subject's responses in terms of the above mentioned categories. The curtain was then lowered, the first object removed, the second test object placed in front of the cage, and the curtain again raised. This standard procedure was followed for the four stimulus objects on the three test days with the test objects outside the cage. On Day 2 the first object was the live mouse, followed by the toy snake, live snake, and toy cat. The order for Day 3 was toy cat, live snake, toy snake, live mouse.

On Day 3, following the standard procedure, the test objects were placed inside the cage in the following order: toy snake, live snake, toy cat, live mouse. The toy cat was not used in all cases. The fourth day used the standard procedure for the first three days, and the order of presentation of objects was that used on Day 1.

E. RESULTS

If it is hypothesized that the fear of snakes in primates is essentially based upon some specific inborn stimulus-response association, then the prediction can be made that snakes will elicit fear in both laboratory-reared as well as jungle-reared animals. The primary finding of this study is that under all *controlled* presentations of the live snake as a test object, no single instance of defecation, ejective or otherwise, or any other extreme expression of emotional disturbance indicative of intense fear on the part of any of the monkeys was observed. In fact, when summed over all subjects, all test stimuli and all test sessions, the frequency of approach responses was significantly greater ($\chi^2 = 44$, $P < .001$) than was the frequency of random and avoidance responses. These observations are quite contrary to the findings of Masserman

and Pechtel, who reported that their monkeys "... reacted with various degrees of horripilation, alarmed vocalizations, rapid breathing, diffuse movements, ejectile defecation and disturbances of discriminatory patterns . . . that persisted for from 15 to 30 minutes . . ." (11, p. 258). In addition, no distinct or unique fear response patterns were exhibited by any of the monkeys in this group toward the live snake when the snake was presented in a series with the other test objects. Only three instances of defecation upon presentation of objects were recorded throughout the study. None of these defecation responses occurred under the standard presentation condition used on the first three days; rather all three occurred upon presentation of objects directly into the test cage. Two defecation responses occurred upon presentation of the toy snake and one upon presentation of the toy cat. Thus, while some monkeys did show evidence of mild or moderate arousal in the present study when the live snake was introduced directly into the animal's cage, this same type of response also occurred with the introduction of the other test objects into the animal's cage.

Over all days of testing and in both types of testing conditions, the subjects did not exhibit any statistically significant differences in approach and avoidance behavior with regard to the four test objects (Table 2). There

TABLE 2
POSTURAL AND MOVEMENT RESPONSES TO THE TEST STIMULI

	Toy cat	Toy snake	Live snake	Live mouse	Total
Approach and no movement	60	58	57	62	237
Random and approach-avoidance	25	29	32	35	111
Avoidance and threatening	38	31	31	22	122
Total	123	118	120	109	470

Note: Frequencies summed for all Ss over all test sessions. $\chi^2 = 4.81$, $P > .50$.

Note: Frequencies summed for all Ss over all test sessions. $\chi^2 = 4.81$, $P > .50$.
was a slight but nonsignificant tendency to avoid the toy cat more than the other three objects. Visual inspection, on the other hand, does show significant differences between objects; the animate objects, the mouse in particular, evoking more sustained visual fixation ($P < .01$) than did the inanimate objects (Table 3).

Bodily orientation and visual inspection did not show any significant differences between test objects when the objects were presented directly into the animal's cage (χ^2 , $P > .50$ in each case). Most, but not all, subjects with-

TABLE 3
VISUAL FIXATION RESPONSES TO THE TEST STIMULI

	Toy cat	Toy snake	Live snake	Live mouse	Total
Few-brief	38	48	44	36	166
Many-brief	20	15	18	25	78
Sustained	15	15	23	42	95
Total	73	78	85	103	339

Note: Frequencies summed for all Ss over all test sessions. $\chi^2 = 17.36$, $P < .01$.

drew slightly at the initial presentation of each object into the cage, and about half of the subjects approached the objects after a few moments inspection. The test period of three minutes was too brief to determine whether or not all subjects would have eventually approached the test objects, but it is the impression of the experimenters that a greater number of them would have done so had the time been sufficiently extended.

A comparison of the laboratory- and zoo-reared monkeys with jungle-reared monkeys shows no statistically significant differences between the two groups in approach and avoidance behavior with respect to the four test objects (Table 4). The laboratory raised subjects did tend to show proportionately more avoidance responses to animate objects, but the difference is not significant.

TABLE 4
MOVEMENT RESPONSES OF LABORATORY- AND ZOO-REARED vs. JUNGLE-REARED SUBJECTS
TO THE FOUR TEST STIMULI

	Toy cat	Toy snake	Live snake	Live mouse	Total
Approach and no movement responses					
Lab and zoo Ss ($N = 6$)	26	25	24	24	99
Jungle Ss ($N = 8$)	34	33	33	38	138
Random and approach- avoidance responses					
Lab and zoo Ss ($N = 6$)	10	12	11	11	44
Jungle Ss ($N = 8$)	15	17	21	14	67
Avoidance and threatening responses					
Lab and zoo Ss ($N = 6$)	16	14	18	13	61
Jungle Ss ($N = 8$)	22	17	13	9	61
Total	123	118	120	109	470

Note: Frequencies summed over all test sessions.

The two groups do not differ significantly in their visual exploration behavior ($P > .20$). The jungle-reared group does tend to show higher fre-

quencies of rapid and repeated visual scanning behavior, but the difference does not approach statistical significance (Table 5).

TABLE 5
VISUAL FIXATION RESPONSES OF LABORATORY- AND ZOO-REARED *vs.* JUNGLE-REARED SUBJECTS TO THE FOUR TEST STIMULI

	Toy cat	Toy snake	Live snake	Live mouse	Total
Few-brief fixations					
Lab and zoo Ss ($N = 6$)	17	22	23	17	79
Jungle Ss ($N = 8$)	21	26	21	19	87
Many-brief fixations					
Lab and zoo Ss ($N = 6$)	7	5	5	9	26
Jungle Ss ($N = 8$)	13	10	13	16	52
Sustained fixations					
Lab and zoo Ss ($N = 6$)	9	8	12	20	49
Jungle Ss ($N = 8$)	6	7	11	22	46
Total	73	78	85	103	339

Note: Frequencies summed over all test sessions.

The total group of subjects included two infants, eight adolescents and four adults. The three age groups did not differ in frequency of brief visual fixations, but the infants showed significantly more ($P < .01$) sustained fixations than did the adolescent and adult subjects over all test objects and over all test sessions (Table 6).

TABLE 6
VISUAL FIXATION AND MOVEMENT RESPONSES OF SUBJECTS BY AGE GROUPS

	Infants ($N = 2$)	Adolescents ($N = 8$)	Adults ($N = 4$)	Total
Visual fixation				
Few-brief	26	87	53	166
Many-brief	3	67	8	78
Sustained	30	50	15	95
Total	59	204	76	339
Movement responses				
Approach and no movement	40	149	48	237
Random and approach-avoidance	9	82	20	111
Avoidance and threatening	41	65	16	122
Total	90	296	84	470

Note: Frequencies summed for all test stimuli over all test sessions.

No significant differences between the age groups were found with respect to approach or random responses. The infants did, however, show significantly

more avoidance responses ($P < .001$) than did the adolescent and adult subjects over all test objects and over all test sessions (Table 6).

A few protocols recorded from the observation notes may best illustrate the types of responses made by the monkeys in the test situation. The first example provides a description of the most disturbed behavior displayed by one subject. The other examples characterize the behavior more typical of all subjects.

S-2, Shirley, adolescent female, captured in the jungle at about six months of age; age at testing, 22 months: On test Day 1 she appeared quite excited at the presentation of each test object, showing withdrawal and vocalization. She attempted to get out the far end of the cage when the toy cat was presented. She exhibited a great deal of random movement in the test cage, but made several approaches toward the toy snake, the live snake, and the live mouse, apparently for closer visual inspection of these objects.

On the second test day, her behavior was similar, but less agitated and with fewer withdrawals. Her strongest reaction was again to the toy cat, which was presented last in the series.

The third test day shows greater approach tendencies, fewer and less extreme withdrawals, with the toy cat still the most disturbing object.

Following the standard presentation on Day 3, each of the test objects was introduced directly into the cage. The subject's response to each test object involved continuous attempts to escape, with frequent vocalizations. There were no approaches toward any object, and only the live mouse drew any sustained visual fixation. The subject urinated and defecated upon presentation of the first object, the toy snake. This is one of a total of three recorded instances of evacuation upon presentation of any test object.

An example of a subject showing a more moderate level of response, and one more representative of the majority is given next.

S-9, Norma, adolescent female, captured in the jungle at about six months of age; age at testing, 22 months: On Day 1 she appeared quiet and undisturbed in response to all test objects. She occasionally approached the objects and looked at them briefly, but showed little overall sustained interest.

The behavior on the second and third test days was essentially the same. The subject would show an initial interest in each object, and then rapidly lose interest and sit quietly or slowly roam around the cage.

When the test objects were presented in the cage on the third day, her behavior was more varied. With the introduction of the toy snake, she began to run back and forth in the test cage, watching the object almost continuously. She quickly calmed down, came over and sniffed the snake and put her hand

on the cage within inches of the snake. This subject's response to the live snake was essentially the same as that to the toy snake. When she came over to sniff at the live snake, however, the snake struck at her, and she quietly withdrew to a corner of the cage and remained there. The live mouse aroused a more active interest on the subject's part. She followed the mouse around and tried to catch it, in what appeared to be a playfully aggressive manner. The mouse appeared terrified. The toy cat was not placed inside the cage. As soon as the subject saw it outside of the cage, she withdrew and began running back and forth in the cage, obviously agitated. The toy cat was quickly removed.

The majority of the subjects responded in an essentially similar way to S-9, some with slightly greater interest in the objects, some with almost complete indifference. The behavior of some subjects tended more toward approach and contact with the test objects as the following example will illustrate.

S-11, Juliet, adolescent female, born and raised in the laboratory; age at testing, 28 months: On test Day 1, this subject's responses to the test objects were quite varied. When the toy cat was presented, she withdrew at first and looked away. She then began to inspect the object more carefully, approaching the front of the cage for a sustained look. Later on she again withdrew to the rear of the cage.

The toy snake did not produce any notable reaction. The subject remained at the rear of the cage and glanced at the object several times. There was no apparent agitation.

When the live snake was presented, the subject stayed at the rear of the cage for about one minute, occasionally glancing briefly at the object. The movement of the snake appeared to attract her attention and she later approached to the front cage for a closer, sustained inspection.

In this subject, the live mouse aroused the greatest interest. Upon presentation of the mouse, the subject quickly approached to the front of the cage and observed the mouse with great interest.

The second and third test days revealed decreasing interest in all test objects. On the second day there was no avoidance of any object, and relatively little interest was observed for any object with the exception of the live mouse. Interest decreased even further on the third day, but the mouse was still of greater interest than the other test objects.

When the four objects were introduced into the cage on the third day, this subject manipulated each of them. She grabbed the toy snake and pulled it; she also pulled the live snake out of the experimenter's hand into the

cage, picked up both the toy cat and the live mouse and threw them around the cage.

With regard to the above observation, the manner in which the live snake was presented into the animal's cage may be of relevance. The experimenter, wearing a white laboratory coat and white cotton gloves would hold the snake about midway along the body. When grasped in this manner the snake stretched out straight, and its head and half of its body were then introduced into the cage through the grid side. Up to the above recorded test, this procedure had worked repeatedly without any difficulties. Following the above noted trial, however, the snake showed an extreme avoidance response to entering the cage with a monkey. This avoidance response persisted in the snake for two succeeding test periods before it extinguished. The mice, which made no serious attempts to escape from the test cage when left alone, also rapidly learned to escape through the mesh sides if they received any rough handling by a monkey. It thus appears that snakes and mice can readily acquire a fear of monkeys.

F. DISCUSSION

The results of this study, specifically the absence of any instance of a specific fear response to a snake, support the conclusions of those prior studies which indicated that the primates' fear of snakes is experiential rather than innate. Particularly, the results of this study are consistent with prior findings concerning the importance of movement and novelty as essential stimulus characteristics for the evocation of fear responses. The present findings, however, suggest that the role of movement as a stimulus characteristic is more complex than has been previously suggested by studies dealing with emotional behavior, since movement appears to play a role as much in the arousal of interest as in the arousal of fear. This particular point has been adequately demonstrated with regard to novelty by Welker (17).

In general, movement appears to be a more potent stimulus characteristic than novelty. Movement, however, may in itself be a novel characteristic when it appears in a familiar but previously immobile stimulus object.

The effect of novelty was measured by reactions to the test stimuli on repeated presentations. No significant differences were found with respect to specific test objects on repeated presentation. Two measures did, however, show significant changes with repetition when summed over the test objects. The subjects showed more avoidance responses and more sustained fixation ($P < .01$ in each case) during the first presentation of the test stimuli than they showed at later presentations. Thus, those subjects who responded with

startle or fear reactions on the first day of testing were less fearful on successive days. Similarly subjects who showed a great deal of interest at the initial presentation of the test objects tended to show reduced interest on successive days of testing.

The presentation of the test objects directly into the subjects' cage reintroduced several elements of novelty into the test situation. Both animate and inanimate objects moved, at least during the presentation period, and all the objects which had previously been inaccessible were now accessible for manipulation. There is no question, on the basis of the observations made, that direct presentation of the objects produced an intensification of both approach and avoidance responses. In general, the subjects tended to be consistent in the type of response exhibited under the standard testing condition and the direct presentation condition. The immediate presence of the object in the cage tended to produce an initial caution in most animals, though a few made immediate approach responses. Adaptation to the stimuli was more rapid during direct presentation than under the standard test conditions, and fewer of the animals remained passive to the stimulus objects in terms of postural orientations and visual fixations.

A third variable in the study, namely age, showed some relation to the subject's response during testing. In general, adolescent monkeys, not unlike human adolescents, tend to be quite excitable. During the direct presentation, the adolescent subjects showed the most active avoidance and also the most aggressive contact with the stimulus objects. During the standard presentations they showed considerable variability in behavior (in part, perhaps because they constituted the largest group of subjects), ranging from passive interest to startle, active interest, and aggression.

The adults tended to be generally more passive and disinterested during the standard presentations of the test objects and also during the direct presentations. The one exception to the last observation was the quite active approach made by S-5, an adult male, to all test objects introduced into the test cage.

The two infant subjects were also quite variable in their responsiveness in both test situations; at times they were calm and curious with long visual fixations of the stimulus objects along with approach to the plexiglass screen; at other times they were extremely fearful, hiding behind the towel attached to the side of the test cage near the plexiglass window. This fearfulness did not appear to have any specific relation to the stimulus objects in most instances. Removed from the home cage, the infant monkey is characteristically quite timid, and will often go into a convulsive type of behavior if an

adequate security object, either the mother or some mother surrogate, is not present for contact. One attempt was made to present the test objects directly to the infants without the presence of a surrogate mother. Before the testing could proceed, the infants went into convulsions, and quite possibly were not even aware of the test objects when they were presented. Direct presentation of the test objects in the presence of a surrogate mother (towel), however, produced no evidence of great fear, both subjects at some point approaching the test objects and one of them (S-4) reached out and touched the toy snake.

While there were no significant differences between laboratory-reared and jungle-reared subjects such minor differences as were observed can easily be accounted for by the age variable, specifically the fact that the two infants were both in the laboratory-reared group.

The failure of even one monkey to exhibit intense or even mild fear to snakes would be sufficient to throw considerable doubt on a nativistic interpretation of the inborn basis of specific fear reactions to reptiles. The fact that many of the subjects in this study, and numerous subjects in other studies of this problem, have failed to show any real evidence of fear of snakes makes nativistic interpretation highly untenable. The laboratory-reared subjects had certainly never seen a snake before and thus there would be no basis for having acquired any fear of reptiles. In fact none of the laboratory-reared subjects showed any selective fear reactions toward snakes, as compared with the responses that were made to novel stimulus objects. In the case of the jungle-reared animals, there is no basis for presuming any experience with snakes, either positive or negative, since in fact, little fear of snakes was demonstrated by these subjects. The results of this research are in accord with the observations of Antonius (1), who found no selective fear of snakes in a large-scale comparative study that included a wide variety of new-world and old-world monkeys as well as anthropoid apes. He also observed that in most cases the snake elicited visual exploration, curiosity, and active attempts to contact and manipulate the snake.

The question may well be raised, why then have so many other investigators and observers reported that monkeys display intense fear of reptiles? Obviously, under some conditions, some monkeys may have exhibited a violent fear of snakes, and if their fear manifested itself in the dramatic manner described by Masserman and Pechtel (11), the observer could hardly fail to be impressed. The case with prior experimental investigations in this area is somewhat different and more difficult to evaluate. In some instances the criteria for fear of snakes were failure to approach or contact the snake, and actual

avoidance or escape behavior (see Yerkes and Yerkes, 19). Another criterion that has been used has been the failure to obtain, or delay in obtaining, food placed in proximity to a snake. A careful reading of these papers hardly leads one to the conclusion that all or even most monkeys are terrified by reptiles. The question of the possible origins of such fears is even more obscure.

The results of the present study indicate that the monkey's fear of reptiles, when it exists, may well be a matter of past experience and possibly to some extent a matter of individual temperament, since the subjects as a group did not demonstrate any distinct fear reaction pattern to snakes.

How then, do such fears develop, and to what extent are they specific to snakes or snake-like objects? First of course, in the case of jungle-reared monkeys, there is always the distinct possibility of an unpleasant encounter with a snake. In view of the one-trial learning possibilities in primates, there would be little basis for questioning the fact that one such traumatic encounter could be sufficient to produce a generalized fear of snake-like objects.

In the case of monkeys born and raised in a zoo, at least in the local zoo, there is usually little likelihood of any direct contact with snakes. Many of these animals would, however, have had the possibility of being exposed to hoses, both garden and fire variety, which are used for the purpose of controlling larger animals, and they might possibly have had the experience inflicted upon themselves. One or more experiences of this nature definitely open up the possibility of a generalized fear of hose-like objects, which could well include snakes.

The laboratory-reared subjects present a different problem, for they had certainly never seen a snake before, nor had they had (or witnessed) any unpleasant experience with a hose. The problem is, however, hypothetical since none of these subjects demonstrated any specific fear of snakes or snake-like objects.

It is quite probable that fear of reptiles, when it occurs in primates, is at least in part also conditioned by social factors. In humans, fear of snakes may be often acquired at a fairly early age. Similarly with monkeys living in colonies, the young will be caught up in the generalized terror that permeates the colony when one of the members exhibits a fear in response to a snake, or any other stimulus object. Conversely, a primate reared in an environment where snakes are not fearsome objects may not become fearful, as exemplified by the instance reported by Tinklepaugh and Hartman (15, p. 281), who placed a garter snake in the cage with two infant monkeys and their mothers. They report:

To our surprise neither the mothers nor the babies demonstrated fear of the reptile. The mothers followed it about the cage and only when it moved quickly after being touched by one of them did they withdraw from it in any manner. The babies, which were at that time between a month and six weeks old, were interested in the snake and had they not been restrained by their mothers would have stepped on or seized hold of it.

However, there is another possibility which must be considered. In the absence of inborn fears of specific objects or classes of objects, there may be some nonspecific predisposition or unconditioned set for fear to develop more readily in relation to certain classes of objects, or environments.

Fear of darkness may be a case in point. This fear is quite prevalent among humans including adults as well as children. In discussing this fear, Valentine (16) offers the following quotation:

Professor Burt remarks "Let us imagine two experimenting mothers, one trying to condition her child so that it should be frightened by the dark and the other trying to condition hers so that it should be frightened by the sun. There seems to me no doubt that the former would succeed as easily as the latter would fail."

A somewhat comparable situation may exist with regard to fear of snakes. Because of certain stimulus qualities of snakes, such as form, size, speed of movement, and tactual qualities, it may be easier to condition a primate to fear snakes than would be the case for a variety of other objects. It is possible that the movement of a snake manifests some dynamic or physiognomic qualities which are emotionally disturbing to primates.

Many authors have noted that both monkeys and children sometimes manifest fear in response to a dismembered body. The motion of a snake, with no visible means of locomotion may very well arouse fear or some awe in an observer. The importance of movement in a stimulus has been noted several times. It is not an unusual experience in a natural environment to mistake a snake for a stick, in which case the sudden movement which results may be sufficient to startle most persons or animals.

Size, particularly in conjunction with movement, is also of importance. Observation of both monkeys and children, and most often adult humans also, easily reveals that large moving objects will produce caution and even fear in an individual who is unfamiliar with the object. Antonius (1) makes the point that if size alone were considered, it would be necessary to postulate an innate fear of large cats (i.e., tigers) but not of small cats, as well as assuming an innate fear of large snakes but not necessarily of small snakes. The possibility that certain stimulus characteristics have a compelling quality

and may be linked to responses such as *startle* or *fear* is an hypothesis which requires further study. It is, however, a very different order of hypothesis from those which propose an innate response pattern to a given object or class of objects.

The implications of the present study are that further controlled investigations are essential to determine the specific stimulus qualities which appear to have the greatest significance or generality for fear arousal in primates. Many previous studies have attempted to clarify this problem by matching animate with inanimate stimuli in the tests. An approach which would induce unusual movement characteristics in non-fear-producing stimuli or an adaptation of Michotte's (14) techniques for studying qualities of movement suggest themselves as promising approaches to further research on this problem.

G. SUMMARY AND CONCLUSIONS

Fourteen experimentally naive rhesus monkeys ranking in age from two months to nine years were tested under controlled conditions to determine whether or not monkeys would exhibit a specific fear of snakes. The alternative explanations of fear as innate or acquired were tested by comparing the responses of laboratory- and jungle-reared animals. Four test objects were presented to each subject: a small toy cat, a toy snake, a live garter snake, and a live mouse. All four stimulus objects were presented behind a clear plexiglass screen each day for three successive days. Following this standard test procedure, on the third day, each object was introduced directly into the subject's test cage.

The results of this experiment provide no evidence for any specific or universal fear of snakes in these primates. The majority of the subjects tended to be passive toward the snake and many responded to the snake with curiosity and interest in the test situation. No differences which could be attributed to the subjects' past history (i.e., laboratory-reared vs. jungle-reared animals) were found.

Movement and novelty both appeared as relevant variables for the arousal of fear responses, which is in agreement with the findings of prior studies of this problem. Both of these variables, however, also appeared to be capable of arousing the subjects' interest and curiosity in the test objects as evidenced by visual exploration, approach responses, and even contact and manipulation of the test objects. In addition, age appeared as a relevant variable as evidenced by both fear responses and more sustained interest in the test objects. Infants tended to show both more sustained visual fixation, and higher

frequencies of avoidance responses to the test objects than did the older monkeys.

These results provide no basis for attributing any specific fear of snakes or snake-like objects in these primates to any innate determinants. The possibility that certain form and movement characteristics of a stimulus might be particularly suitable for conditioning fear responses in primates was considered, however, and suggestions for further research along these lines were indicated.

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THE RELATIONSHIP OF INTELLIGENCE-TEST SCORES TO THE EASE OF LANGUAGE CONDITIONING*¹

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A. PROBLEM

A number of experiments have attempted to demonstrate a relationship between intelligence-test scores and the ease of establishing a response by classical conditioning. Mateer (5) and Darrow and Heath (2) demonstrated a positive relationship between conditionability and intelligence-test scores. However, Campbell and Hilgard (1) and Kuroda (4) were unable to show such a relationship.

In view of the conflicting evidence it must be concluded that a relationship between ease of conditioning and intelligence-test measures has not been conclusively demonstrated. However, the responses investigated previously were primarily simple reflex behaviors conditioned on a first-order basis. A relationship might yet be shown using higher-order conditioning and responses which are more relevant to complex human behaviors such as those involved in language behavior.

One aspect of language development which seems relevant to behaviors measured by intelligence tests is the establishment of word meaning. Word meaning is considered by Mowrer (6), Osgood (7), and Staats and Staats (9), to be a response, and the Staats' have demonstrated that meaning is acquired according to the principles of classical conditioning.

Higher-order language conditioning has been shown to take place when a stimulus word (UCS) which has previously been conditioned to elicit a meaning response (rm) is paired with another word (CS) which elicits no meaning response (9). The meaning response elicited by the UCS word becomes conditioned to the CS word and constitutes its meaning.

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It would seem appropriate to employ this type of higher-order conditioning in an attempt to test the relationship between ease of conditioning and measures of intelligence. Since the extent of one's vocabulary may be dependent in part upon the ease with which one acquires new meanings, and the extent of this type of verbal learning is important to measures of intellectual behavior, a positive relationship between intelligence-test scores and the ease of higher-order language conditioning would be expected.

B. METHOD

1. *Subjects*

SAT Verbal Scale scores (College Entrance Examination Board Scholastic Aptitude Test) which were available for 1900 students entering Arizona State University in the fall of 1958, were divided at the upper and lower 10-percentile levels of the distribution to form high- and low-intelligence groups. Thirty-two of these students, currently enrolled in elementary psychology classes, were randomly selected from each intelligence group and subsequently run in individual conditioning sessions with the order of *Ss* randomized. Participation in the experiment met a requirement of the course.

2. *Procedure*

A modification of the conditioning procedure employed by Staats and Staats (9) was used. Four CS nonsense syllables (YOF, XEH, LAJ, GIW) were separately flashed on a wall by a slide projector for a period of five seconds each. Approximately one second after each presentation the *E* said one of the UCS words out loud. The *S* was instructed to learn the syllables by looking at them; and, the words by hearing and pronouncing them. The *S* repeated the UCS word aloud once, then said the word over to himself until the syllable was removed. The *S* was told that, after the simultaneous presentation of the two types of materials, he would be separately tested on each learning task.

In order to reduce the possibility of direct associations being formed between syllables and words by the repetition of UCS words, a syllable was paired once with 12 different words, each of which elicits a common meaning response. YOF was presented with 12 words which elicit a positive evaluative meaning (e.g., Beauty, Gift, Sweet); XEH was paired with 12 negative evaluative words (e.g., Ugly, Bitter, Criminal); LAJ was presented with words which elicit a common meaning of sharpness (e.g., Spike, Lance, Dagger); and GIW was paired with words each of which elicits a meaning

of roundness (e.g., Balloon, Wheel, Ball). The 48 syllable-word pairs were randomly ordered and presented in the same sequence to all Ss.

Following the conditioning trials, each *S* was presented a booklet containing the four CS syllables and two filler syllables in random order. Each syllable was presented with an appropriate seven-point semantic differential scale (8). GIW, LAJ and QUG appeared with a Sharp-Round scale, while YOF, XEH, and JIC appeared with a Pleasant-Unpleasant scale. The *S* was instructed to indicate on the scale how he felt about each syllable. He then answered questions from which was established the degree of his awareness of the systematic presentation of words and syllables.

C. RESULTS

The extent of evaluative meaning conditioned to the CS syllables was measured for each *S* by subtracting the semantic differential scale rating of YOF from that of XEH. Since opposite meaning was conditioned to these syllables, the extent of conditioning was indicated by the difference score. The mean conditioning score was 2.38 for the high-intelligence group, and .88 for the low-intelligence group. A *t*-test analysis of the differences between these means yielded results significant beyond the .025 level using a one-tailed test ($t = 2.24$, $df = 62$). This test of significance was considered appropriate according to the criteria established by Kimmel (3). Thus, Ss who scored high on the intelligence test acquired significantly stronger evaluative meaning responses to the nonsense syllables than did Ss who scored low on the intelligence measure.

A similar analysis for sharp-round conditioning was conducted by subtracting the rating LAJ from that of GIW for each *S*. The mean conditioning score for the high-intelligence group was 1.75, and for the low-intelligence group, .78. An analysis of these difference scores yielded a *t* of 1.18 ($df = 62$), which was not significant using a one-tailed test ($P < .15$). The means and SDs for these analyses are presented in Table 1.

Low- and high-intelligence-test Ss were then grouped according to their awareness of the relationship between syllables and the word class with which a syllable was paired. Those Ss who were aware on one or more syllables comprised one group, and Ss aware on none of the syllables comprised the other group. A chi-square analysis indicated no significant differences between intelligence groups with respect to awareness ($\chi^2 = 3.56$, $df = 1$, $P < .10$).

D. DISCUSSION

A positive relationship between ease of conditioning and intelligence-test

TABLE 1
MEANS AND *SDs* OF DIFFERENCE SCORES FOR MEANING CONDITIONED TO
NONSENSE SYLLABLES

	Evaluative meaning (XEH—YOF)		Sharp-Round meaning (GIW—LAJ)	
	Mean	<i>SD</i>	Mean	<i>SD</i>
High- intelligence group	2.38	2.67	1.75	3.34
Low- intelligence group	.88	2.64	.78	3.10

scores was demonstrated in that stronger evaluative meaning responses were acquired by high-intelligence-group *Ss* than by low-intelligence-group *Ss*. Although the difference between intelligence groups with respect to sharp-round meaning was not statistically significant, the results were again in the predicted direction of stronger conditioning for high-intelligence-group *Ss*.

This difficulty in conditioning the sharp-round dimension as compared to the evaluative dimension, is consistent with earlier findings of Staats and Staats (9), which showed that evaluative meaning is more readily conditioned to nonsense syllables than other components of meaning, such as potency and activity components.

Previous attempts to relate intelligence-test scores to the ease of establishing a conditioned response dealt primarily with the first-order conditioning of simple reflexive behaviors which may be only indirectly related to the behaviors measured by intelligence tests. The present results are suggestive that ease of conditioning is an important variable when responses are relevant to behaviors ordinarily measured on intelligence tests, and where higher-order conditioning is involved.

The results of this study indicate that it would be profitable to investigate the relationship between intelligence-test scores and more complex learning such as is involved in problem solving, thinking and reasoning, language development and usage, and communication, as it is these more complex behaviors which are considered to be a part of the behavioral repertoire of "intelligent" organisms.

E. SUMMARY

The relationship between intelligence-test scores and the higher-order conditioning of word-meaning responses was investigated.

The ease with which *Ss* acquired conditioned-meaning responses to neutral

verbal stimuli was related to verbal-scale scores on the College Entrance Examination Board Scholastic Aptitude Test. Sixty-four Ss who scored above the upper or below the lower 10-percentile level of their class were individually run in the higher-order language-conditioning procedure of Staats and Staats (9).

Results indicated that the high-intelligence-test group acquired significantly stronger evaluative meaning responses than did the low-intelligence-test group, as measured by semantic differential scores. The conditioning of sharp-round meaning was not significantly different for the intelligence groups, although the results were in the expected direction of stronger conditioning for high-intelligence-test Ss.

The obtained positive relationship between ease of conditioning and intelligence-test scores was considered to be a result of having employed a higher-order conditioning procedure and a type of behavior which is relevant to the complex behaviors ordinarily measured on intelligence tests.

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THE DEVELOPMENT OF SECOND-GENERATION LOW-PROTEIN RATS*

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A. PURPOSE

For some time this unit¹ has been investigating the effects of a low-protein diet on the behaviour of successive generations of white rats. The results have indicated that the low-protein diet has little effect on the parent generation, but that the first filial-generation rats are retarded in intelligence (2, 3) and that they are more emotional (+) than rats retained on a normal laboratory diet.

The present report describes the effects of a low-protein diet on the growth, development and the emergence of certain response patterns in a second filial generation of low-protein rats. The report also describes the results obtained on testing the rats on the Hebb-Williams test of animal intelligence.

B. METHOD

1. *The Sample*

First-filial-generation low-protein rats were mated at 120 days of age with normal male laboratory rats. The offspring constitute a second filial generation of low-protein rats, and form the sample used in the present study.

After they had been mated with the normal male rats from the laboratory colony, 15 low-protein rats and eight comparable control rats were kept in individual wire cages measuring $30 \times 21 \times 21$ cm. The temperature of the breeding room varied between 21° – 26° C, with a mean temperature of 24° C.

Table 1 shows the number of pups and litters born, and the mean number of pups in each litter in the low-protein and the control groups.

The pups were weaned at 35 days of age, the low-protein pups being retained on the low-protein diet. In the control group 2.4 per cent of the pups died before weaning, and in the low-protein group 20.2 per cent died. The

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TABLE 1
COMPOSITION OF THE LOW-PROTEIN AND THE CONTROL GROUPS

	No. of litters	No. of pups born	Mean no. of pups per litter	No. of pups dying	% of pups dying
Control	4	42	10.5	1	2.4
Low-protein	12	89	7.4	18	20.2

number of pups used in the developmental testing ranged between 71-89 in the low-protein group and between 41-42 in the control group.

At 104 days of age, 14 male rats from the control group and 14 male rats from the low-protein group were randomly selected for testing on the Hebb-Williams Test of Intelligence. The testing procedure was the same as that described by Rabinovitch and Rosvold (12). Twelve female rats from the low-protein group and 11 female rats from the control group were also tested on the Hebb-Williams test at 170 days of age.

2. Developmental Testing

The rats were examined once each day, the time of the examination being kept constant.

a. Growth curves. From the second day after birth until the eighth day the litters were weighed daily. At weaning, when the ears were clipped and the sexes separated, the pups were weighed individually.

b. Motor coordination. Each rat was placed for two minutes on a porcelain tile, which had been marked off from the centre in one-inch and thereafter half-inch concentric circles. The circles were numbered from the centre of the tile to the periphery.

The number of segments over which the pup moved on the tile was recorded, together with the presence or absence of head and limb movements. The pups were placed in the centre of the field and facing in the same direction. The procedure was repeated each day from the second day after birth until the tenth day.

c. Unfolding of the external ear flap. The number of days after birth elapsing before the upper flap of the ear unfolded, was recorded.

d. Reaction to sound. From the 10th day to the 15th day, the pups were placed individually in a small enclosure measuring approximately six inches square, and their response to a sharp sound was recorded. The sound was produced by allowing the bob of a pendulum to fall freely from the horizontal position, through an angle of 90°, to strike the tin sheeting of the side of the field. The thread of the pendulum was 127 centimeters long and the brass

bob weighed 18.1 grams. The presence or absence of the startle response to the sound was recorded.

e. Upper incisors. The number of days after birth before the upper incisors broke through the gums was recorded. A blunt metal probe was moved gently across the gums in order to ascertain whether the incisors had broken through the gums.

f. Opening of the eyes. The age at which the eyes of the rats opened was noted.

g. Suckling of the pups. From the second day after birth until weaning, recordings were made three times a day as to whether the rat litters were suckling from their mothers. The times chosen for making the observations were selected at random from hourly intervals between 8 a.m. and 5 p.m. A litter was regarded as suckling if the majority of pups was feeding from the mother.

3. The Diet

The diet used in the investigation was similar to that previously described (2). The protein composition of the control diet has been observed to vary between 20.1–21.5 (mean 21.3) per cent, and that of the low-protein diet between 12.97–15.60 (mean 14.49) per cent. The fluctuation in the protein composition of the diets may well be accounted for by seasonal changes in local foodstuffs and more particularly in the quality of the fish meal used. The mineral and vitamin mixtures used in the low-protein diet were supplied by the National Nutrition Research Institute (6). The composition of the low-protein and the control diets is shown in Table 2.

The composition of the low-protein diet was based on the work of Miller and Platt (10), who, on the basis of their analysis of a diet in a rural area of the Gambia, compounded a diet in which the foodstuffs, though of European origin, closely corresponded in amount to the Gambian diet.

C. RESULTS

1. Growth Curves

Mean differences in the weights of the experimental and the control group are shown in Figure 1. On the second day after birth a mean difference of .5 grams is observable between the two groups, the mean weight of the control pups being heavier than that of the low-protein pups, even though the mean number of pups per litter is larger in the control group.

The mean daily increase in weight of the control rats, over the period extending from the second until the tenth day, is significantly greater than

TABLE 2
COMPOSITION OF THE LOW-PROTEIN AND CONTROL DIETS

Control	%	Low-protein	%
Yellow maize meal	56	Ground whole wheat	75
Milk powder	16	Fish meal	7
Ground nuts	6	Ground cooked haricot beans	5
Brewers' yeast	5	Dextrine	5
Fish meal	8	Ground nut oil	2
Carcass meal	4	Mineral mixture	1*
Lucerne meal	3	Vitamin mixture	2**
Bone meal	1	Vitamin A & D	.007
Calcium	.5	Lucerne meal	3
Salt	.5		
Vitamin A & D ₃	.1		
Percentage protein	21.3	Percentage protein	14.49

* Percentage composition: CaCO_3 , 20.0; K_2HPO_4 , 22.83; $\text{CaHPO}_4 \cdot 2\text{H}_2\text{O}$, 22.57; $\text{Na}_2\text{HPO}_4 \cdot 12\text{H}_2\text{O}$, 11.74; $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$, 8.07; NaCl , 7.66; Ca-lactate , 5.05; Fe-citrate , 1.96; KI , .05; $\text{MnSO}_4 \cdot 2\text{H}_2\text{O}$, .02; $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$, .02; ZnCl_2 , .02.

** Composition (parts per 100,000): Riboflavin, 30.00; thiamine hydrochloride, 25.00; niacine, 500.00; pyridoxine hydrochloride, 125.00; calcium pantothenate, 200.00; choline chloride, 5,000.00; inositol, 5,000.00; p-amino-benzoic acid, 1,500.00; biotin, 2.00; folic acid, 25.00; vitamin B₁₂ ("Cytacoon"), .13; vitamin K ("Kapilin"), 5.00; ascorbic acid, 500.00; dextrine to make 100,000.

the mean daily increase in the experimental rats (two-tailed Mann-Whitney U test, $p < .01$).

At both the 35th and 60th days after birth the mean difference in weight between the groups is significant beyond the .1 per cent level ($t = 11.023$ and $t = 5.630$).

2. Motor coordination

a. Head movements. Donaldson (5) and Farris (7) have drawn attention to the characteristic searching movements of newborn rats. While the majority of the low-protein and the control rats showed head movements of this sort, a minority in both groups failed to do so.

The number of experimental rats not showing head movements was greater in the low-protein than in the control group from the third day after birth. The difference between the two groups was significant on the sixth day ($\chi^2 = 14.04$; $p < .001$), and on the seventh day ($\chi^2 = 4.93$, $p < .05$), after birth.

b. Limb movements. Paddling movements of the fore and hind limbs are observable in the majority of the control rats (83 per cent) from the fifth day, and in the low-protein rats (64 per cent) from the seventh day after birth. The chi-squared test shows the difference between the groups to be

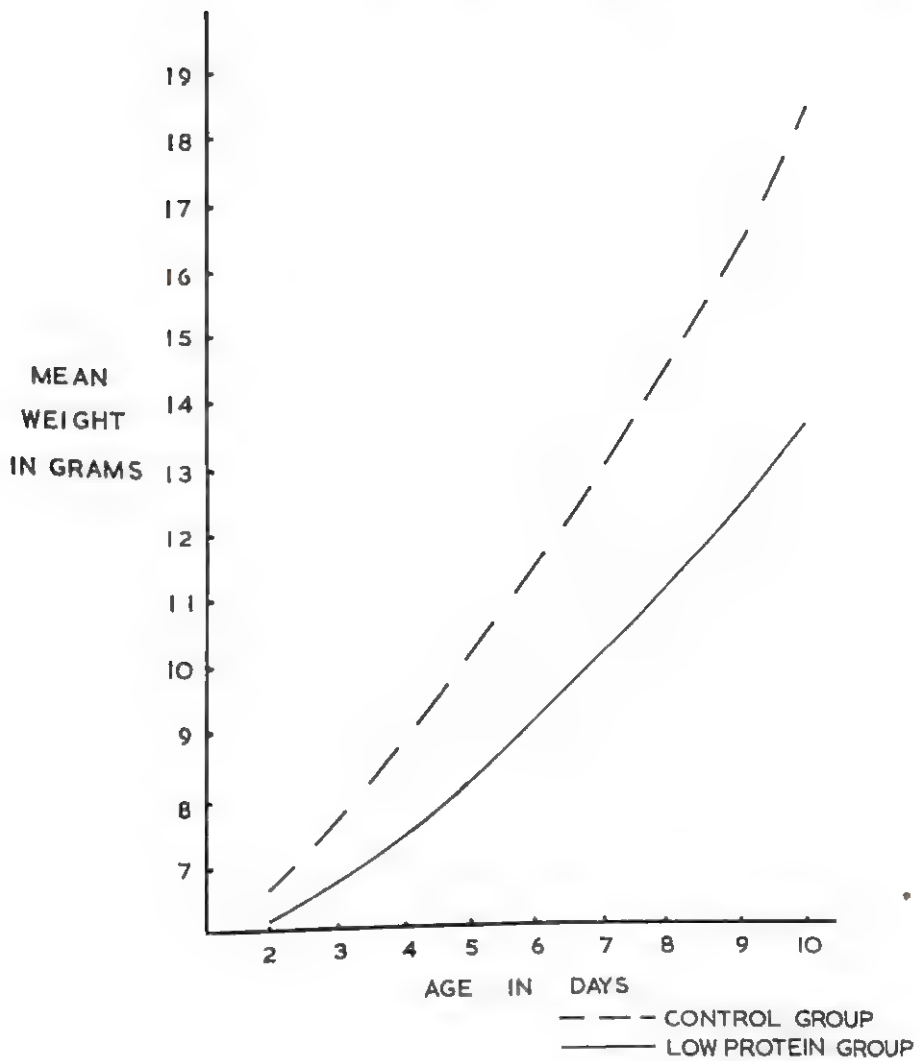


FIGURE 1
GROWTH CURVES OF THE CONTROL AND LOW-PROTEIN LITTERS

significant at less than the .1 per cent level on the fifth ($\chi^2 = 15.20$) and sixth days ($\chi^2 = 19.68$), and at less than the 1 per cent level on the seventh ($\chi^2 = 7.20$) and eighth ($\chi^2 = 9.80$) days. From the ninth day the differences between the low-protein and the control group are not significant.

c. Coordinated movement in the field. When placed in the field many of

the rats showed movement which was restricted to the centre of the field and the first segment.

A comparison was undertaken between the number of rats entering the four outer segments of the field, and the number of rats remaining in the centre and the first segment of the field.

By the fifth day 76 per cent of the control rats and 30.7 per cent of the low-protein rats had moved beyond the periphery of the first segment ($\chi^2 = 21.95$, $p < .001$).

The difference between the number of rats in the low-protein and control groups moving beyond the first segment of the field is also significant on the sixth day ($\chi^2 = 36.96$, $p < .001$), seventh day ($\chi^2 = 19.28$, $p < .001$), eighth day ($\chi^2 = 13.48$, $p < .001$) and ninth day ($\chi^2 = 4.77$, $p < .05$) after birth.

The mean number of segments entered each day, over the nine-day observation period by the control group, was greater than the mean number of segments entered each day by the low-protein group (two-tailed Mann-Whitney U test, $p < .05$).

3. *Unfolding of the External Ear*

In the low-protein group the pinnae of the ear remained unfolded for a longer period than in the control group. In only 16 per cent of the low-protein, but in 50 per cent of the control rats, were the external pinnae unfolded by the second day after birth ($\chi^2 = 15.41$, $p < .001$). On the third day, the difference between the groups was again significant, 76 per cent of the low-protein group and 95 per cent of the control group having had the pinnae unfolded ($\chi^2 = 5.87$, $p < .02$). By the fourth day all the rat pups, with the exception of one in the low-protein group, had the pinnae unfolded.

4. *Reaction to Sound*

The control rats responded to sound at an earlier age than the low-protein rats. The earliest response that was recorded was in two control rats at 10 days after birth. On the 12th day, 93 per cent of the control rats and 30 per cent of the low-protein rats were observed to respond to the noise ($\chi^2 = 43.09$, $p < .001$). On the 13th day the difference between the groups was again marked: 98 per cent of the control rats and 57 per cent of the low-protein rats responding to the noise ($\chi^2 = 20.64$, $p < .001$). By the 14th day all the control rats and 80 per cent of the low-protein rats showed a marked startle response to the noise ($\chi^2 = 6.84$, $p < .01$), but from the 15th day the differences between the groups were not significant.

5. Upper Incisors

The upper incisors of 36 per cent of the control rats and 26 per cent of the low-protein rats had broken through the upper gums by the eighth day after birth ($\chi^2 = .840$, $p > .3$). On the ninth day the difference between the control group (88 per cent) and the low-protein group (69 per cent) was significant ($\chi^2 = 4.44$, $p < .05$), but by the 10th day practically all the pups of both groups had their upper incisors.

6. Opening of the Eyes

One of the control rats had both eyes open on the 14th day after birth. By the 15th day 60 per cent of the control rats and 22 per cent of the low-protein rats had their eyes open ($\chi^2 = 16.62$, $p < .001$). The difference between the group was also significant on the 16th day ($\chi^2 = 15.07$, $p < .001$), but not on the 17th day ($\chi^2 = 1.82$, $p > .2$) after birth.

7. Suckling of the Pups

The control and the low-protein mothers were ranked on the number of times they were observed suckling their pups during the preweaning period. The low-protein mothers suckled their litters more frequently than the control group (two-tailed Mann-Whitney U test, $p < .02$).

8. Hebb-Williams Test

The results obtained on the Hebb-Williams test are shown in Table 3.

TABLE 3
MEAN DIFFERENCE IN INTELLIGENCE BETWEEN THE LOW-PROTEIN AND THE CONTROL RATS

Group	Mean low-protein (errors)	Mean control (errors)	Standard deviation low-protein	Standard deviation control	<i>t</i>	<i>p</i>
Male	119.5	94.1	22.41	23.09	2.9512	$< .01$
Female	151.8	143.8	19.60	13.60	1.1264	$< .3$
Male & Female	134.4	116.0	26.40	31.60	2.2580	$< .05$

D. DISCUSSION

The results show clearly that in second-generation low-protein rats there is a retardation of growth and a delay in the emergence of certain early response patterns.

From the second day after birth the low-protein rats are lighter in weight than the control group and, as in first-generation rats, this difference in

weight becomes greater as the rats mature (2). The mortality rate is significantly higher in the low-protein rats, but is considerably less than that which we have observed in first-filial-generation rats.

It is likely that the slightly higher protein content of the experimental diet used in the present investigation, was primarily responsible for the reduced mortality rate. It is our impression, however, that the constant handling of the rats during early infancy may also have contributed to the lower mortality rate.

Previously, we observed no difference in the frequency with which first-filial-generation low-protein rats suckled from their mothers (4). The greater frequency with which the second generation suckle may indicate that, over the two generations, the low-protein diet has had a cumulative effect on either the quantity or quality, or both quantity and quality, of the mothers' milk.

Retardation in motor development is reflected in the greater number of low-protein rats that do not show the early characteristic head movements, and the delayed appearance in this group of paddling movements of the fore and hind limbs. Further, early coordinated creeping movements are less effectively executed than by the control rats, where the criterion of effectiveness is the distance travelled in the field. Work in progress indicates that the low-protein diet may have a retarding effect on the motor development of first-filial-generation rats, though it has little effect on the temporal development of the sense organs and other anatomical features.

The eyes, and the external ear flap, open at a later age in the second-generation low-protein rats. The low-protein rats also respond at a later age than the control rats to sound, and this inclines us to the view that concurrent with the anatomical retardation there is a retardation in the functioning of the receptors.

In the present study, only the male rats show a significant difference in intelligence, though the scores of the female rats on the Hebb-Williams test are in the same direction as those of the males. The testing of the female rats at a later age than the male rats, may have contributed to the failure to obtain a significant difference in this group. Biel (1), in studying the effects of inanition on the rat, found that differences in maze learning were present at an early age, but were not permanent. In our own studies there is much that runs counter to this view. First-filial-generation low-protein female rats when tested on the Hebb-Williams test at 80 days of age, and male rats at 180 days of age, both scored a significantly greater number of errors than comparable control rats (2, 4). These results, taken in conjunction with

the results of the male rats and the combined male and female scores of the second generation, indicate that the changes induced by the low-protein diet are persistent and so present in the mature rat.

Critical periods in the development of behaviour have been described, and associated with critical periods of learning. Structural changes within the nervous system, receptors and effectors presumably accompany the critical periods, and the periods would themselves be dependent on these changes (15).

The retardation in development of the low-protein rats occurs at an early age, and, if we may generalize from other species, this period may well be critical for the establishing of certain response patterns. Failure to establish such patterns, in the case of children, may lead to permanent disabilities in later life (15).

The developing brain during the foetal period and early infancy rapidly synthesises protein and lipoproteins, which Richter (13) has indicated make up 90 per cent of the dry weight of the brain. While the proteins of the brain are reported as being more resistant to depletion during starvation than other tissues, the deformation or death of the foetus may arise from a severe protein deficiency in the mother (13). A number of early studies describing structural changes in the C.N.S. following on the administration of low-protein diets are reviewed by Jackson (9).

Rose *et al.* (14) have shown that the amino acids which are necessary for the growth of the rat are also necessary for the maintenance of nitrogen equilibrium in man. The exclusion, even for a short period, of any one of the essential amino acids in man, produced changes in appetite, sensations of fatigue and marked nervous irritability.

Geber and Dean (8), in a study of African children with Kwashiorkor, a protein deficiency disease, report a retardation in development of the children when assessed on the Gesell tests. It is not known, however, whether the retardation is permanent, though Nelson (11) of this Institute has reported that the dominant E.E.G. frequencies of children with Kwashiorkor are well below those of healthy African children.

The evidence indicates that a deficiency of protein during the prenatal period, early infancy, or both, has far reaching effects on the organism. In rats, there is retardation of intelligence and an increased emotionality in the first generation, and marked retardation of development and intelligence in the second generation.

E. SUMMARY

The effects of a low-protein diet on the growth and development of a second generation of low-protein rats are described.

The low-protein rats are retarded in growth and there is a delay in the emergence of motor activity and in the response of the rats to auditory stimulation. Frequency of suckling was more marked in the low-protein rats.

When mature, the rats were tested on the Hebb-Williams test of intelligence, where they scored a greater number of errors than a comparable control group of rats fed a laboratory diet of known composition.

The results are discussed in relation to the concept of critical periods of development, and attention is drawn to the reported effects of protein deficiency on the nervous system and on the development of African children.

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MODIFICATIONS IN JUNIOR-HIGH-SCHOOL CHILDREN'S
VERBAL BEHAVIOR AS A FUNCTION OF SOCIAL
APPROVAL AND MANIFEST ANXIETY*

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A. INTRODUCTION AND STATEMENT OF THE PROBLEM

Considerable research interest and activity have recently been focused on operant verbal conditioning. A majority of these investigations have been excellently reviewed by Krasner (3).

In a previous study, the authors (5), utilizing the Taffel technique (6) with elementary-school children, demonstrated that both verbal and physical (head nod) approval were effective reinforcers of a class of verbal behavior. No demonstrable effects of sex, experimenter, or manifest anxiety upon the acquisition of verbal behavior were obtained. In addition, the "awareness" dimension could not be evaluated since no *S* was "aware" by the criteria employed.

Developmental variables have generally been neglected by investigators concerned with the effectiveness of reinforcers on the learning behavior of children. One of the research areas previously proposed by the authors as in need of systematic investigation was the influence of developmental variables on the acquisition of verbal behavior as a function of social approval. It is commonly assumed that certain types of reinforcement vary in their effectiveness with developmental factors. For example, it is generally held that early adolescence is featured by heightened rebelliousness against authoritative or prestigious figures. One might conjecture that verbal approval by an adult *E* might not have the reinforcing value obtained with younger children. However, this "well-known" fact is not substantiated, in large part, by empirical investigation.

The present investigation proposed to study some of these developmental variables by replicating the previous elementary-school study using junior-high *Ss*. More specifically, as in the previous study, the present study was concerned with the variables of relative efficiency of two types of social reinforcement, manifest anxiety, *E* differences, sex of *S*, "awareness" dimension

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and the possible interactive effects with developmental variables like chronological age on the modification of verbal behavior.

B. METHOD

1. *Subjects*

Ss were 90 public-school children from an Iowa town of 8000. Their mean age was 13.63 years and they were in the seventh, eighth and ninth grades. Age and grade were proportional throughout with each of the three age-grade levels making up one-third of the group. There were 60 boys and 30 girls; 20 boys and 10 girls from each grade. This is comparable to the sex ratio from emotionally disturbed children seen at the State University of Iowa's Child Psychiatry Services and was established because the present investigation has implications concerning clinical activities and future related research with such children.

All Ss had an *IQ* of 85 or above according to school records, had no apparent physical incapacity or handicap, were not under narcotic medication, and were not misplaced more than one age-grade level in school. No *S* had been a resident of an institution (orphanage, delinquent, or psychiatric) and none had a history of arrests or juvenile-court involvement.

2. *Materials*

The materials consisted of the Children's Manifest Anxiety Scale (CMAS) (1) and 60 stimulus cards.

The stimulus cards were three by five, white, unlined index cards. Sixty commonly used, neutrally toned, past-tense verbs at a reading level of third grade or below were selected. A different one was typed in capitals in the middle of each card. Six pronouns—I, we, he, she, they, you—were typed in capitals below each verb with their respective orders randomized for the series of 60 cards.

3. *Task*

The experimental task consisted of making up sentences using the verb on the stimulus card and *S*'s choice of one of the six pronouns.

4. *Procedures*

The CMAS was group-administered in the "study hall" by the junior-high-school principal. Standard CMAS instructions were given.

The CMAS was scored according to standard procedure and a high-low median split was made (Median = 16.79). The children were placed in sampling groups according to sex, grade, and high-low anxiety and names were

drawn randomly from each to compose the treatment groups. There were three treatment groups:

1. Group VA, in which *E* responded immediately with verbal approval, using a smile and the word "good" said in a moderately enthusiastic and sincere manner, following each sentence in which *S* used the personal pronouns *I* or *we* (class of verbal behavior).

2. Group PMA, in which *E* responded immediately with physical movement, using a smile and vertical head nod in an approving manner following sentences using *I* or *we*.

3. Group C, a neutral or control group, in which *E* made no response following any sentence.

Each treatment group was composed of 15 high-anxious and 15 low-anxious *Ss*, five high-anxious and five low-anxious from each of the three grades, with the two-to-one sex ratio maintained throughout. "A" Scale and L Scale scores ranged from two to 35 and zero to nine respectively for the experimental sample. One *S* had an L score of nine, two had scores of eight, and all others had L scores of seven or below.

The investigators were introduced to the children by the principal, who told them that names had been drawn to determine participants for a language activity with *Es*. *Ss* were taken to the experimental room individually and seated at a table directly across from *E*.

The following instructions were given:

This is a language activity in which you may make up sentences. Here is a stack of cards with words on each like this (*E* pointed to stack with sample card on top). There is a word in the center (*E* pointed) of each card. For each card, look at the word in the center, then look the bottom words over, and then choose any *one* of the bottom words to *start* a sentence that uses the word in the center. That is, make up a sentence starting with any *one* of the bottom words and then the one in the middle. It doesn't matter if your sentence is long or short—you make up any sentence you want to. Most people find it helpful to just say the first sentence that pops into their mind. This activity will not affect your school marks or standing in any way. I will use a type of shorthand to write down all the sentences you make up. OK? Any questions? You ask them now because after we get going it will be hard for us to stop the activity to talk about them. Remember then make up a sentence starting with any *one* of the bottom words and then the word in the middle. Here we go with the first card.

The first card was turned over, followed by each in the stack. *Ss* did not report, nor did their questions indicate, difficulty in understanding the procedure and none perseverated on any one pronoun.

All *Ss* were treated alike during the presentation of the first 15 cards to establish a base level. *E* simply exposed the stimulus card, recorded the response, and exposed the next card. This sequence constituted Block 1 and the next 45 cards were divided into Blocks 2, 3, and 4 consisting of 15 cards each. *E* responded differentially, according to the treatment groups above, on all cards following Block 1. The cards were thoroughly shuffled between *Ss* in an attempt to control order effects. *E* alternated treatments from *S* to *S* in verbal approval, physical-movement approval, and control sequences to randomize *E* day-by-day differences throughout treatment groups. An equal number of *Ss* from each treatment group were run each day. It required three consecutive days to run the 90 *Ss*, 30 each day. About 12 to 15 minutes were needed for each *S* to complete the task.

Following completion of the task, *Ss* were asked the following questions to give some indication of the awareness of the relation between their responses and *E*'s responses (6):

1. Did you usually give the first sentence that entered your mind?
2. How did you go about deciding which of the words on the bottom to use?
3. Which do you think you used the most times?
4. Why?

Two *Es*, the investigators, were employed. They each ran half the boys and girls in each grade-treatment-anxiety group. Such a procedure provided some control over possible *E* differences by exposing the groups equally to the *Es*.

A difficulty, which should be noted, was encountered during preliminary testing of the methods. To serve as an effective reinforcer, the inaudible head nod must be seen by *S*. However, some preliminary *Ss* continued to look at the card or elsewhere following their response. A procedure was adopted in which *E* did not record *S*'s response until he looked up. Within a few trials, all *Ss* looked at *E* following each sentence. *E* then recorded the sentence and turned the stimulus card over.

C. RESULTS

The criterion measure for all *Ss* was the frequency of sentences beginning with *we* or *I* within each block of 15 trials. The effect of social reinforcement upon the *we* and *I* class of pronouns was to increase the response frequency of this class. The usage of *we* or *I* in the first 15 sentences was selected as the basal level of frequency. An analysis of variance was performed on the Block-1 data to determine if any significant differences could be demonstrated

at the outset of training. This analysis yielded nonsignificant findings ($F = .839$).

In order to assess the effects of anxiety level for each treatment condition, a Type II analysis of variance (4) was conducted, in which anxiety level and treatments constituted "between Ss" factors, while trials and those interactive effects which included trials were "within Ss" factors. The summary table of the results of this analysis of variance is presented in Table 1.

TABLE 1
SUMMARY OF ANALYSIS OF VARIANCE OF THE USE OF REINFORCED PRONOUNS AS A
FUNCTION OF TREATMENT CONDITIONS AND ANXIETY
($N = 90$)

Source	df	Mean square	F	p
Between subjects	89	23.72		
Treatment conditions (C)	2	67.12	2.91	ns
Anxiety (A)	1	33.01	1.43	ns
C \times A	2	2.97	0.13	ns
error (b)	84	23.07		
Within subjects	270	4.53		
Trials (T)	3	32.92	8.12	.001
T \times C	6	13.00	3.21	.05
T \times A	3	0.83	0.21	ns
T \times C \times A	6	3.41	0.84	ns
error (w)	252	4.06		
Total	359	9.28		

The analysis indicated that the main effects of treatment conditions, anxiety and their interactive effects were not significant. It will be noted that the trials by treatment-condition interaction is significant ($p < .05$), in which the differences among the treatments vary over trials.

Separate Type III analyses were done to assess the effects of sex and examiner upon the rate of acquisition of the reinforced class of pronouns. Sex or examiner influences and their respective interactions were not significant by these analyses.

Graphic representation of these data is presented in Figure 1 with the variables of anxiety, sex of S and examiner collapsed over treatment conditions.

A Type I analysis of variance indicated that the treatments by trials interaction was significant ($f = 3.25$; $df = 6, 261$; $p < .01$). An analysis of Block 4 indicated that these groups differed significantly ($f = 5.79$; $df = 2, 87$; $p < .01$). The differences between the three means revealed that the VA group learned significantly more than the PMA group ($t = 2.00$, $p < .05$) and the control group ($t = 3.21$, $p < .01$). However, the PMA group did not differ from the control group ($t = 1.06$, $p > .05$). To determine if these three groups used the first-person pronouns more frequently on

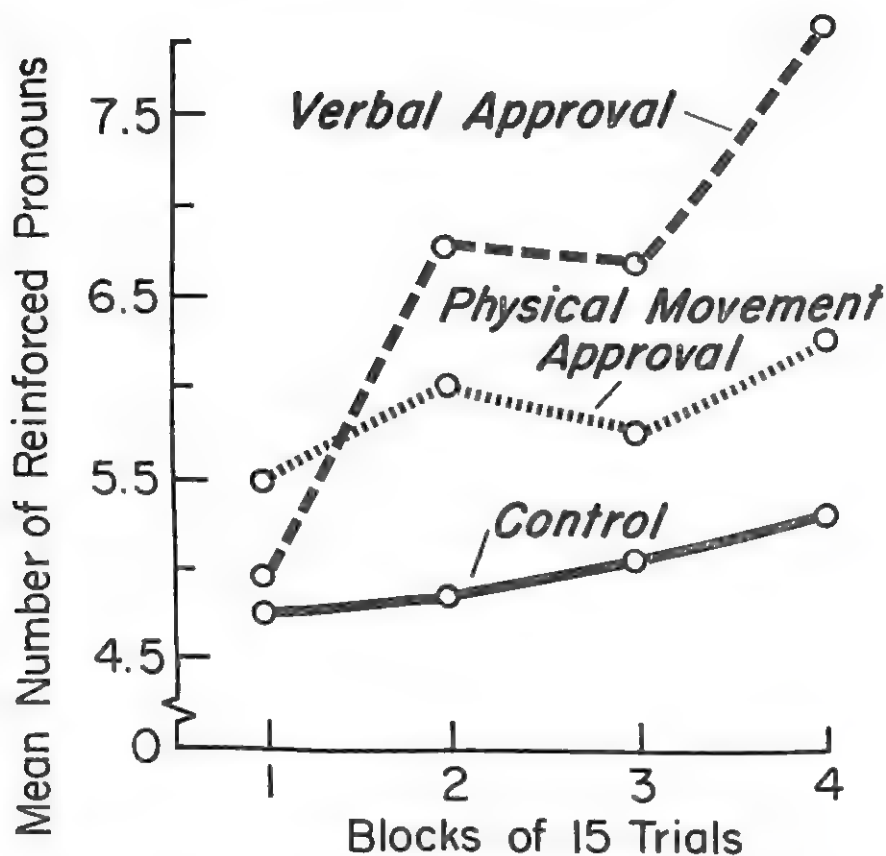


FIGURE 1
MEAN NUMBER OF REINFORCED PRONOUNS USED PER BLOCK OF 15 TRIALS

the fourth block than on the first block, a t test for related samples was carried out over these two trial blocks for each treatment group. The results indicated that a significant increase in preference for *we* and *I* pronouns occur in the VA group ($t = 5.21$, $p < .001$), but not in the PMA group ($t = 1.58$) and the control group ($t = 0.75$).

Since the method for assessing awareness in our S s did not reveal any "aware" S , the influence of this factor could not be evaluated in our study.

In comparison with a previous study using elementary-school children (5), similar findings were obtained with respect to the effects of anxiety, sex of S and examiner. While both experimental conditions produced significant effects in elementary-school children, the head-nod (PMA) reinforcer was not effective with the junior-high population.

D. DISCUSSION

The present investigation confirms the findings obtained with elementary-school children (5) with respect to sex of *S*, examiner differences and the effect of manifest anxiety upon the acquisition of the reinforced pronouns. The implications of anxiety or motivational level as proposed by Castaneda, Palermo, and McCandless (2) were not demonstrated. Since the present investigation was not presented as a "learning" task *per se*, the failure of the CMAS to reflect either facilitation or interference with the rate of acquisition may be attributable to this. However, one may well have predicted a positive relationship between anxiety and rate of acquisition in view of the relative simplicity of the task.

The previous findings of increased usage of the reinforced words are generally confirmed for the verbal approval, but not for the nonverbal reinforcement. The reason for the limited effectiveness of the physical-movement reinforcer significantly to alter junior-high *Ss*' responses while increasing the usage of the reinforced class of pronouns in elementary-school children is not readily apparent.

The method of questioning utilized in the present investigation failed to reveal any *S* who was able to state the contingency that the increased usage of the criterion response had occurred in association with the verbalization of approval or physical expression of approval by *E*. In view of the lack of any direct evidence of this contingency, it would seem justifiable to assume that learning in the predicted direction occurred without conscious awareness by *Ss* of the intentions of *E*. This finding substantiates previous results obtained with elementary-school *Ss* (5).

In general, with the exception of the failure to replicate the efficacy of the physical-movement reinforcer, no developmental differences were found. What effect the degree of involvement of a child with significant prestigious persons—such as parents, teachers or psychotherapists—may have on the conditioning of verbal behavior remains an open question. Experimental investigation of children with emotional disturbances and the subsequent effect of these disturbances on operant conditioning of verbal behavior would also appear to be of interest. According to the criterion of "awareness" employed in this study, the children were "unaware." However, it may be useful to consider more open-ended types of questionnaires and/or probing techniques to assess this variable.

E. SUMMARY

This study investigated the operant conditioning of a class of verbal be-

havior as a function of manifest anxiety and two types of social approval in junior-high-school children. Anxiety levels were inferred from the Children's Manifest Anxiety Scale. Social reinforcers consisted of a "head nod" and the verbalization "good." With the exception of the failure of the physical movement reinforcer (head nod) significantly to affect learning, the present study confirmed the results obtained with elementary-school children. Since developmental variables seemingly do not affect operant conditioning of verbal behavior, other variables for research with children were proposed.

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MINIMUM-SEPARABLE VISUAL ACUITY OF RHESUS MONKEYS AS A FUNCTION OF AGING AND WHOLE-BODY RADIATION WITH X-RAYS*¹

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A. INTRODUCTION

This was an investigation of minimum-separable visual acuity of rhesus monkeys as a function of aging and exposure to WBR with X-rays and was an outgrowth of experiments of Davis, Elam, and McDowell (3) and Brown and McDowell (1). These investigators reported deficits in minimum-separable visual acuity of Ss that had been exposed to large doses of WBR with a mixed source of neutron and gamma radiation.

Geldard and Crockett (5) reported differences in minimum-separable visual acuity between young and aged human Ss, which suggests the possibility that similar differences would be found in comparable groups of primates that are not human.

B. METHODS

1. Subjects

Fifteen rhesus monkeys were used in this experiment. They were divided into three groups of five Ss each as follows: (a) a group comprised of Ss 2.0 to 4.0 years of age, hereafter called the young group, (b) a group of old monkeys, 9.0 to 10.0 years of age, that had served as controls in a study of radiation effects (Davis, McDowell, Deter, & Steele, 4)—the aged non-irradiated group, and (c) a group of Ss aged 9.0 to 10.0 years with a previous exposure of 1100 r WBR with X-rays administered in three dosages between 1953 and 1955. These Ss will be referred to as the aged irradiated group. All Ss in this experiment had extensive laboratory training and the training received by each of the Ss in the two older groups was nearly identical.

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2. Apparatus

The Wisconsin General Test Apparatus (WGTA) was used throughout this experiment. Stimuli were photographic figures of one complete circle and 10 broken circles, the former identified as the constant stimulus, the latter as the variable stimuli. Each stimulus was mounted on a 4.0-by-4.0-by-0.125-inch square of Masonite. The circles had an outside diameter of 1.6 inches and a line width of 0.06 inch. The size of the breaks in the 10 variable stimuli were 180, 90, 45, 22, 14, 7, 4, 2, 1, and 0.5 degrees. In addition to the photographic figures, two sets of steriometric stimuli were constructed. Each set consisted of a constant stimulus and a variable stimulus with a 180-degree break. Stimuli of one set were raised 0.25 inch. Stimuli of the other set were of the same configuration raised 1.0 inch. The raised figures were constructed of copper tubing 1.6 inches o.d. and had a wall thickness of 0.06 inch. These figures were painted black and securely cemented to 4.0-by-4.0-by-0.125-inch squares of Masonite which were painted white. Two 20-watt fluorescent tubes illuminated the stimuli with 48 footcandles of light as measured by a MacBeth Illuminometer.

3. Procedure

A constant stimulus was paired with a variable stimulus in each trial. The position of the food, which was one-half a seedless grape, varied randomly from trial to trial, and the variable stimulus followed the position of the food. A noncorrection method of training was used.

The stimuli were displayed at an angle of 50 degrees from the horizontal and were placed over two food wells with centers 12.0 inches apart. The Ss were thus able to view the stimuli perpendicular to their line of sight. Each S was required to extend its arm at least 80 per cent of its maximum reach. Davis (2) showed that monkeys discriminated stimuli most efficiently if forced to make a nearly maximum reach in order to displace objects. Since Ss varied in the length of their maximum reach, the distance between S's eye and the stimulus varied 6.0 inches among individual Ss. The effect of the eye to stimulus disparity on acuity was controlled by employing a constant distance during the final period of training.

a. Preliminary training. All Ss were trained on a constant stimulus paired with a variable stimulus having a 180-degree break. The training was divided into two periods. Subjects were given 20 trials each day to discriminate the photographic figures of the constant stimulus and the variable stimulus with the 180-degree break during the first period of 16 days. The second period began on the seventeenth day and continued throughout the remainder of preliminary

training. It was instituted in order to facilitate *Ss'* discrimination of the circle and half circle. The photographs of these stimuli were presented for 20 trials each day, and the three-dimensional representations for 20 trials. Ten of the latter trials employed the stereometric stimuli that were raised 0.25 inch and 10 used stimuli that were raised 1.0 inch. The occurrence of the three different pairs of stimuli was randomized. All *Ss* were trained until they met a criterion of not more than two errors for each of two consecutive days with the 20 pairs of photographic stimuli. Thirteen of the 14 *Ss* met the criterion within 28 days, and the remaining two *Ss* were given 40 and 56 days of training respectively.

b. Generalization training. Each successive condition of generalization training employed the constant stimulus paired against variable stimuli with increasingly more complete circles ranging in order from 90.0 through 1.0 degrees. Forty trials per day were given to each *S*, and included trials of three different difficulties presented randomly. Twenty-four were of a difficulty not yet mastered, and eight were of a difficulty of each of the last two previously mastered levels of difficulty. This procedure enabled *E* to determine whether failure to meet criterion on the unmastered stimuli was due to factors extraneous to acuity, e.g., inability to generalize or emotional disruption. If *S* met a criterion of not more than three errors on each of two successive days on the 24 trials of the heretofore unmastered condition, it progressed to the next condition. The *S* completed the generalization phase of training if it met the criterion on the 1.0-degree variable stimulus. This phase was terminated if *S* failed to meet a criterion after 16 days of training on any condition of generalization. If *S* met the first day of a criterion on the 16th day a condition was presented, *S* was given an additional day of training.

c. Acuity training. The same 40-trial procedure and the same criterion of success or failure as described for generalization training was used in the determination of minimum-separable visual acuity. The variable stimulus with the 0.5-degree break was paired with the constant stimulus.

If an *S* failed to meet the criterion during any condition, the *S* was given additional training to determine if differences in the distance between the stimulus and *S's* eye had had an adverse effect on performance. Stimuli were placed 8.0 inches in front of the cage bars. Each *S* which was involved in this phase of training was given 40 trials, beginning on the problem preceding the one which *S* had most recently failed.

C. RESULTS

Figure 1 illustrates the average number of errors for young and aged *Ss*

during the three periods of training. There were no significant differences in performance of the three groups during preliminary training. The use of three-dimensional stimuli improved performance in training to discriminate, and the strict criterion of success brought each *S* to nearly perfect performance before training to generalize commenced.

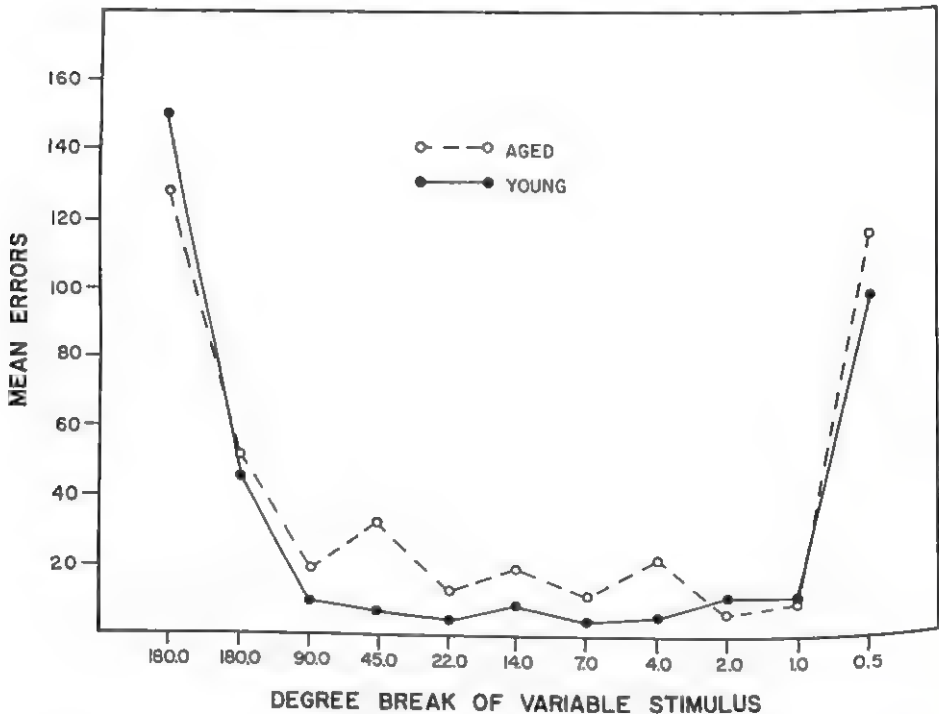


FIGURE 1
PERFORMANCE OF YOUNG AND AGED MONKEYS ON MINIMUM-SEPARABLE-VISUAL-ACUTY PROBLEMS

The figure shows that the performance of the young *S*s was superior to that of the old *S*s from the problem with the variable stimulus containing the 90-degree break to the problem with a stimulus with a 2.0-degree break. The young *S*s spent significantly fewer days on training to generalize than the old *S*s, 22.8 and 40.3 days on the average respectively ($U = 6$, $n_1 = 5$, $n_2 = 10$, $p < .02$). Three of the old *S*s and none of the young *S*s failed to reach all of the criteria of training to generalize. The *S*s that did not complete generalization were two *S*s with a previous history of radiation and one old animal that had not been irradiated. Of the 12 *S*s that completed

this phase of training, the five young *Ss* made significantly fewer errors than the seven remaining old animals ($U = 4$, $p < .03$).

Eleven of the 12 *Ss* that solved the problem with the variable stimulus having a 1.0-degree break made more errors on the next most difficult problem (0.5-degree break in the variable stimulus), and this increase is significant using the Sign Test ($p < .01$). The figure indicated that old *Ss* made more errors than young *Ss* on this problem, but neither this difference nor the difference between the two groups of old *Ss* is significant. The average number of errors per day was 7.1, 8.4, and 8.9 for the old nonirradiated, the old irradiated, and the young *Ss* respectively, and the difference between the two groups of old *Ss* approaches significance ($U = 1.5$, $n_1 = 4$, $n_2 = 3$, $p = .08$). The large number of errors per day that were made by the young *Ss* seemed anomalous to *Es*, who plotted individual response curves to determine the cause of this finding. Three of the five young *Ss* met the criterion with an average of 3.2, 5.6, and 6.2 errors per day, and the other two with 11.4 and 11.7. One of the latter *Ss* (no. 23) approached criterion stochastically and met it on the eighth day. Thereafter its performance deteriorated and reached 23 errors out of 24 trials on the 11th day. This number of errors is highly unlikely by chance on any one day ($p = .000002$). Also, performance of this *S* during the second eight days of practice significantly exceeded that of the first eight days ($t = 3.30$, $p < .02$).

Performance of each *S* on the interpolated trials of the two previously mastered problems was tabulated and the pooled percentages for both of the previously mastered problems was correlated with the percentage of errors made on the problem that was being solved. This analysis was planned to indicate the extent of emotional interference present. None of the old nonirradiated *Ss*, two of the old irradiated, and two of the young *Ss* had significant correlations (.60 or higher using the Spearman Rank Correlation for nine pairs of measures). The median correlation for these three groups was .20, .30, and .55 respectively, and there was considerable individual variation.

D. DISCUSSION

Davis, Elam, and McDowell (3) and Brown and McDowell (1) considered neither the effects of the ability of *Ss* to generalize nor the consequences of frustration that accompanied discrimination near the absolute threshold in reporting their investigations of acuity. The present experiment used the same stimuli as these investigators and modified their methods. Contrary to their finding of increasingly better performance during generalization, the performance of *Ss* in the present study reached and remained at

an asymptote throughout generalization training. Thus the present *Es* regard the significant superiority of the young over the old *Ss* during this part of the experiment as being related to differences in ability to generalize rather than to differences in visual acuity.

Discrimination of the variable stimulus did not become a function of acuity until the variable stimulus with the 0.5-degree break was presented. The groups did not differ significantly on this problem, although the excellence of acuity was in the direction expected from earlier experiments (young, old nonirradiated, and old irradiated *Ss* respectively). When discrimination reaches a threshold, the problem of emotional disruption must be considered. Liddell (6, pp. 389-411) made it quite clear with *Ss* of several species that inability to discriminate during training near the absolute threshold resulted in pathological behavior. The present *Es* provided trials on problems similar to those that had been mastered in order to determine if more errors would be made on the previously mastered problems during the experimental sessions containing difficult discriminations than during the sessions containing easy discriminations. The *Es* assumed that the relationship would provide a measure of the effects of frustration on error production. In several cases the correlation was high and significant although *Ss* showed considerable individual variation. Generally the young *Ss* showed this relationship more than the old *Ss*, and one of the young *Ss* had a significant deterioration of performance on the problem with the 0.5-degree break. This suggests that probably the young *Ss* had better visual acuity than indicated in this experiment, but that their performance was effected by variables other than acuity.

E. SUMMARY

This study investigated the chronic effects of radiation and aging upon the minimum-separable visual acuity of rhesus monkeys. Three groups of five *Ss* each were used, consisting of an aged irradiated group, an aged nonirradiated group, and a young nonirradiated group. The stimuli consisted of a complete circle paired with a broken circle which had 10 successively more difficult stages. The broken circle had forms varying from a circle with a 180-degree break to a circle with a 0.5-degree break. Training was divided into three phases: (a) preliminary training, (b) generalization training, and (c) acuity training.

The results showed that:

1. The young *Ss* were able to generalize significantly better than aged *Ss*; however, no significant differences in acuity or preliminary training occurred between the two groups of old *Ss*.

2. There were no significant differences in performance between old irradiated and nonirradiated Ss in preliminary training, generalization training, or acuity training. Chronic radiation effects in minimum-separable visual acuity were not indicated by this experiment.

3. Evidence of the emotional effects of frustration on the production of errors at the threshold of acuity was presented, and the three groups of Ss appeared to be affected differently.

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BILINGUALISM AND THE MEASUREMENT OF
INTELLIGENCE: REVIEW OF A DECADE
OF RESEARCH*¹

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A. PURPOSE

Bilingualism has been recognized as a complex problem in psychological research for almost half a century. Arsenian (5) and Darcy (12) reviewed the literature on the effects of bilingualism on the measurement of intelligence and, while the findings in the literature are contradictory, the contradictions frequently stem from differences in methods of investigation and the difficulty of separating the alleged language handicap from educational retardation, cultural and socioeconomic conditions, emotional concomitants or any combination of these factors.

This article will be limited, for the most part, to a review of the research, conducted within the past ten years, which has been concerned with the effects of bilingualism on the measurement of intelligence, but, before presentation of a representative number of these studies, it seems pertinent to give a brief overview of some of the problems with which a student of research in this field becomes involved.

B. PROBLEMS IN RESEARCH WITH BILINGUAL SUBJECTS

1. *Divergent Definitions*

The divergent definitions of the term *bilingualism* in the literature add to the difficulty of interpreting the results of studies of bilingual populations. To cite a few examples, Bloomfield (7, p. 56) defined bilingualism as "a native-like control over two languages" while Leopold (25, p. 6) contended that bilingualism is present even when one language is spoken better than the other, as long as both are regularly used as media of discourse. O'Doherty (32) ascribed part of the confusion with regard to understanding the problem of bilingualism to the confusion of the essential and incidental uses of language. He distinguished between the bilingual who has mastered two lan-

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guages as media of social intercourse and the pseudo-bilingual who, technically, may be considered to have some knowledge of a second language but who, in practice, may not have mastered either language. Finally, Tan (41) suggested that bilingualism and monolingualism may be thought of as opposite extremes of a continuum with a continuum for each aspect of language, and added that most people do not attain perfect achievement in all aspects of the vernacular, and that it is rare for bilingualists to approach this goal in two languages.

2. Determining Degrees of Bilingualism

The difficulty of measuring the degrees of bilingualism was ignored by the majority of the early investigators of the problem of determining the effect of bilingualism on measured intelligence, and only the minority of investigators of this problem within the last twenty years have attempted to measure objectively the degrees of bilingualism of the subjects studied.

3. Types of Intelligence Tests Used

The instruments used for measuring the intelligence of bilingual subjects have varied greatly, and the results achieved have shown comparable variance. Many investigators have used only verbal tests of intelligence of a group type, a procedure which can be questioned when testing a bilingual population. While this procedure has become less frequent in the past ten years, it has often been replaced by an equally questionable one of using only non-verbal tests of intelligence. Until the relationship between scores achieved on verbal and on non-verbal tests of intelligence has been proved to be higher than studies of such correlation have indicated, there would seem to be little justification for using a non-verbal test as a substitute for a verbal intelligence test. Seidl (36), in reviewing a large sampling of studies dealing with the relationship between scores on verbal and non-verbal tests of intelligence, found a range in correlation coefficients from .83 to .06. In view of these data, it is suggested (10) that the most promising method of appraising the intelligence of the bilingual child is to administer verbal and non-verbal tests of intelligence, preferably of an individual type.

4. Isolation from Other Environmental Factors

The precise interpretation of results in studies of bilingualism is rendered difficult also by the frequent failure of investigators to isolate the bilingual influence from other environmental factors. Within the last decade several students of the problem of bilingualism in the United States (2, 4, 6, 37, 39),

in Wales (15, 20), in Ireland (32), and in India (43), have recognized bilingualism as part of a wider problem requiring an appraisal of the political, national, social and economic conditions under which a person acquires a second language.

5. *Tests with Time Limits*

Another environmental influence which has been found to have a detrimental effect on the scores of bilingual subjects is the use of intelligence tests with time limits (23, 28, 30, 31). From the results of these studies, untimed tests would appear to be preferable to timed tests for measuring the intelligence of bilingual populations.

6. *Optimal Age to Learn Second Language*

The age which is considered optimal for the teaching of a second language varies from country to country and is affected by the child's cultural environment in a given country. This greatly complicates the problem of the investigator of problems concerned with bilingualism. The indications from research (37, 38) strongly suggest that a second language should not be taught until a child has mastered the vernacular. Penfield (33), however, is of the opinion that a child can learn several languages before the ages of 10 to 14 with little difficulty, because the dominant hemispheres of the brain take on all languages without any geographical separation that can be discovered; whereas, after the age of about 14 years, the brain seems to become more rigid and slower in taking on these functions. Further research is needed before conclusive evidence can be drawn as to the optimal age for beginning the learning of a second language, but the results of the majority of the available studies seem to warrant the conclusion that the bilingual child suffers a language handicap which tends to decrease only when one language becomes dominant.

7. *Relation of Language to Conceptual Thinking*

Closely related to the optimal age for teaching a second language is the problem of determining the relationship of language to conceptual thinking: Since the weight of evidence (18, 28, 34, 41) has indicated that language is necessary in the formation of concepts, it seems reasonable to assume that a child's score on an intelligence test using language will be depressed if he has an imperfect knowledge of the language of the test. The problem of the relation of language to thought as measured by intelligence tests has received scant attention to date.

With these related, if somewhat confusing problems in mind, a representa-

tive number of studies of the past decade which have attempted to meet some of the problems noted above in determining the effect of bilingualism on the measurement of intelligence will be reviewed. The bulk of the literature related to this topic in the last decade has been concerned with Spanish-English bilinguals in the United States and Welch-English bilinguals in Wales. This article will review representative studies of these groups in both countries and will, in addition, consider a few pertinent studies of other bilingual populations.

C. STUDIES OF SPANISH-ENGLISH BILINGUALS

The research on bilingualism and its effect on the measurement of intelligence in the United States in the last decade has centered around the Spanish-English bilinguals, largely of Mexican descent, in the southwestern United States, and around the Spanish-English bilingual Puerto Ricans in New York City.

The Puerto Rican population in New York City presents a complicated educational problem. The native language of Puerto Rico is Spanish. English is taught in Puerto Rico as a separate language or as the language of school instruction usually after grade four, but the grade level varies from time to time. This situation has served to make many Puerto Rican children illiterate in both languages, and to create educational confusion (29, p. 12).

Data published in 1961 by the Board of Education of the City of New York (27), listed 153,694 children of Puerto Rican background who were enrolled in the New York City public schools in October, 1960. These children were either born in Puerto Rico, or born on the United States mainland with one or both parents being Puerto Rican. The population comprised 15.6 per cent of the total number of pupils enrolled in the New York City public schools at that time but, since these statistics did not include the large number of children of Puerto Rican background enrolled in New York City parochial schools, it would seem reasonable to assume that the figures were conservative estimates of the situation in the City of New York.

Though English is used as the medium of instruction in the New York City schools, the Puerto Rican communities retain Spanish as their principal language and, as a result, many Puerto Rican children have an inadequate knowledge of both languages. This may, in part, account for their inferior test performance when verbal intelligence tests are administered in English or in Spanish (4, p. 357).

An investigation of Spanish-English bilinguals in the southwestern United States was made by Altus (1), who studied two groups of retarded children,

one bilingual of Mexican descent and the other unilingual of non-Mexican descent in Santa Barbara, California. The subjects were equated as to age, sex and Performance *IQ* on the Wechsler Intelligence Scale for Children (WISC). The investigator chose the WISC because a study of its standardization data led her to conclude that "at least, in comparing groups, the mean W.I.S.C. Performance I.Q. would serve as a reasonably good predictor of the mean Verbal I.Q. except in samples where such handicapping influences as bilingualism were in operation" (p. 242).

All of the bilingual subjects had been enrolled in the school system of Santa Barbara at some time from 1949-1951, and most of them had been referred to the Guidance Department of the school system as part of the screening process for entrance to special classes for mentally retarded. The classification of bilingualism was accepted if the cumulative record cards indicated that Spanish was spoken exclusively at home or that both Spanish and English were spoken at home. The unilingual group came from school referrals also, but the primary reason for referral was maladjustment.

Differences between the two language groups in *IQs* on the Verbal Scale of the WISC averaged 17 points in favor of the unilinguals. The bilinguals achieved a mean Verbal *IQ* of 72.02, *SD*, 14.25; whereas the unilinguals achieved a mean Verbal *IQ* of 88.98, *SD*, 14.20. All the verbal subtests showed statistically significant differences at the 1 per cent level of confidence or better to exist between the two groups, with the most striking discrepancies on Vocabulary Information and Similarities, in that order. On the Performance Scale, however, the bilinguals achieved a Performance *IQ* of 84.01, *SD*, 15.75; and the unilinguals achieved a Performance *IQ* of 86.43, *SD*, 14.40. Altus concluded that the scores of the bilingual children on the Verbal Scale probably did not reflect what their achievement would have been if they had been trained in only one language. The English speaking group, on the other hand, showed close correspondence between their *IQs* on the Verbal and Performance Scales.

The subtest patterns of the bilinguals did not correspond to the customary subtest patterns of the adult mentally retarded on the Wechsler test. The author stated that "these results might be of value in the differential diagnosis of borderline cases of psychometric mental retardation within a bilingual Mexican descent population and also offer some evidence as to the handicapping influence of bilingualism in this particular minority group" (p. 247). Further research of a longitudinal nature was recommended to study the differences in verbal and non-verbal scores on intelligence tests, and the effect of continued schooling on intelligence-test scores of bilingual populations.

Anastasi and Cordova (2) administered the Cattell Culture-Free Test, Forms 2A and 2B, to 176 bilingual boys and girls in Grades 6, 7 and 8 whose ages ranged from 11 to 15 years. The subjects attended a parochial school in Spanish Harlem of New York City. Half the group received the test instructions of Form A of the test in English during the first testing session, and this same half received the test instructions of Form B of the test in Spanish during the second testing session. The order of languages was reversed for the other half of the group. The coefficients of reliability in Forms A and B in the English and Spanish versions ranged from .84 to .92, and the authors reported that speed played a negligible part in the obtained scores.

The rating scale to determine the bilingualism of the subjects was adopted from the Hoffman Bilingual Schedule. Nearly all of the parents of the subjects came from Puerto Rico, while nearly half the subjects were born in Puerto Rico and the remaining number in New York City. The majority of the parents, when classified according to the Goodenough and Anderson Scale, were in the semiskilled and the slightly skilled occupational groups.

An analysis of variance was conducted on 108 of the subjects, including 27 boys and 27 girls in each of the two language-order subgroups. Significant *F* ratios were reported for the two variables, subject and session, and for the interaction of order and sex. A most significant finding was the marked improvement of test scores from the first to the second testing session regardless of the order of languages employed. There was no overall sex difference in scores, but the girls performed better when the test order was in Spanish-English and the boys when it was English-Spanish. The investigators attributed this finding to the fact that the more highly Americanized boys responded more favorably to the initially English-speaking examiner, whereas the initially Spanish-speaking examiner achieved better rapport with the less-Americanized girls.

The median standard score *IQ* of the group as a whole was .70, with an *SD* of 24 points. This *IQ* was 1.25 standard deviations below the test norms reported by Cattell in the test manual. The authors attributed this low score to the low socioeconomic status of the parents, to the bilingualism of the subjects which made them deficient in both English and Spanish, to their extreme lack of test sophistication, and to their poor adjustment to the school situation. It was concluded that not only test performance, but also the general intellectual development which intelligence tests are designed to measure, are seriously handicapped by the attitudes and intellectual habits which result from children's early linguistic confusion. The bilingualism of the group was such that the mastery of either language was severely restricted, and

this linguistic bifurcation, it was believed, may have accounted, in part, for the improvement in scores in the retest since by the time the children had received the instructions twice, they had an opportunity to complement their inadequate understanding of either language.

This study is of particular interest and importance because of questions it raises for further research related to the multi-causes of low scores on intelligence tests of selected bilingual groups.

Anastasi and de Jesus (4) attained measures of language development and Goodenough Draw-A-Man *IQs* for 25 Puerto Rican boys and 25 Puerto Rican girls who attended day nurseries in New York City. All of the subjects were within six months of their fifth birthdays and their scores were compared with those of 50 white and 50 Negro children who had been tested by the same procedure in an earlier study by Anastasi and D'Angelo (3). The testing of the Puerto Rican children was done by a Puerto Rican examiner, and Spanish was spoken exclusively to each child though his responses were recorded in the language of his choice.

The intelligence-test results, which are of prime concern in this review, are as follows: The mean *IQs* on the Goodenough Draw-A-Man test for the Puerto Ricans were 88.88 for the boys, 102.52 for the girls, and 95.70 for the entire Puerto Rican group; whereas, the mean *IQs* for the white subjects were 99.00 for the boys, 105.64 for the girls, and 102.32 for the entire white group. The mean *IQs* of the Negro subjects were 96.88 for the boys, 103.28 for the girls, and 100.08 for the entire Negro group. The *IQs* of the Puerto Rican girls were significantly more variable than the *IQs* of the Negro girls and the white girls. The *IQs* of the Puerto Rican boys were significantly more variable than those of the Negro boys, and while the difference in variability between the *IQs* of the Puerto Rican boys and the white boys was in the same direction, it did not meet significance at the 5 per cent level of confidence.

The authors suggested that the lower scores achieved by the Puerto Rican children on the intelligence test may have been affected by their introduction to an English-speaking school situation at a time when they knew little or no English and had a corresponding lack of maturation for academic tasks. It is important to note also that the educational and occupational levels of the parents of the Puerto Rican children were markedly lower than those of the Negro and white parents.

Carrow (8), as part of a larger study of the relationship of bilingualism to the mastery of language, administered the Otis Quick Scoring Mental Ability Test, Non-Verbal, Form A, to 50 bilingual and 50 monolingual

children chosen from the third grades of four elementary schools in San Antonio, Texas. The bilingual children had been exposed to Spanish and English since infancy and preferred to be tested in English. Their bilingual classification was determined by interview with their parents. The monolingual subjects spoke only English. Each language group had equal representation from the major socioeconomic categories on the Bachman Scale and equal sex ratio. The difference between the two language groups in mean *IQs* on the Otis Non-Verbal test yielded a *t* ratio of .83. This difference was not significant at the 5 per cent level of confidence.

Darcy (11) studied 235 bilingual Puerto Rican children in the fifth and sixth grades of two New York City public schools. The children were selected from the nine classes of these grades on the basis of a questionnaire which had been designed to determine the degrees of bilingualism. Those selected for study heard and spoke Spanish at home always or almost always, whereas they heard and spoke English at school always or almost always. The subjects ranged in age from 14 years, 10 months to 10 years, 4 months with a mean chronological age of 12 years, 3 months. The Pintner General Ability Test, Intermediate Form B, was used as the verbal test of intelligence and the Pintner Non-Language Test, Form K, was used as the non-language intelligence test. The assumption was made that when the intelligence of the subjects was measured by means of verbal and non-verbal tests, their scores on the non-verbal test should be significantly higher than those achieved on the verbal test if bilingualism were acting as a language handicap. If, however, significant differences were not found to exist between the scores of the bilingualists on the verbal test and on the non-language test, bilingualism was not to have been considered as a handicap when measuring their performance on verbal tests of intelligence.

Not more than 48 hours elapsed between the administration of the two tests, and the order of administration varied systematically so that any possible effect it might have had on the test results would have been cancelled.

The mean *IQ* of the 235 subjects on the non-language test was 87.84 with an *SD* of 16.52, whereas the mean *IQ* on the verbal test was 79.56 with an *SD* of 14.31. The difference in mean *IQs* of 8.28 points, in favor of the non-language test, was significant at the 1 per cent level of confidence. The obtained difference in mean mental ages was 8.62 points in favor of the non-language test and this difference was significant at the 1 per cent level of confidence. These significant differences in mean *IQs* and in mean mental ages were substantiated when the total group of subjects was divided into its nine school classes. In all nine classes, there were appreciable differences between

the mean *IQs* and between the mean mental ages on the tests, and these differences were in favor of the scores achieved on the non-language test.

The Pearson coefficient of correlation between the *IQs* achieved on the Pintner Verbal Test and on the Pintner Non-Language Test was .58 with a PER of .03 and the Pearson coefficient of correlation between the mental ages achieved on the verbal and non-language tests was .42 with a PER of .04. These correlation coefficients are too low to warrant the substitution of one test for another, but they are highly reliable since the coefficient of correlation between the *IQs* achieved is more than 19 times its probable error, and the coefficient of correlation between the mental ages is more than 10 times its probable error.

The author concluded that the two tests were measuring the same functions to a fairly large extent, but not to so great a degree as to warrant the substitution of one test for another, and drew the implication that the administration of intelligence tests of both verbal and non-language types yields a more valid picture of intelligence of a bilingual population, such as the one studied in this investigation, than does the administration of either a verbal or a non-verbal test as the sole means of appraisal.

Johnson (16) studied 30 Spanish boys in a town in the southwestern United States to determine the relationship between their scores on verbal and non-verbal tests of intelligence, and to note the role which the degree of bilingualism as measured by a reaction-time technique played in this relationship.

All of the subjects used English in school and had a knowledge of Spanish. The degree of bilingualism was determined by the Hoffman Bilingual Schedule and a Reaction Time Test of Bilingualism. The latter was designed by Johnson to determine the facility with which an individual can manipulate the symbols of a language and to compare this facility for each of the two languages. The ratio between the number of English words recalled in five minutes and the number of Spanish words recalled in five minutes was determined for each subject in half of the group. A similar procedure was used with the other half of the group except that the language sequence was changed. The difference between the results in the two language-sequence groups was found to be insignificant, but the scores of the Reaction Time Test revealed that the subjects were able to respond with more English words than Spanish words at an approximate ratio of 7 to 5.

The author stated that the Hoffman Bilingual Schedule and the Reaction Time Test appeared to be measures of common factors since their relationship with the tests of intelligence were in the same direction, but the Reaction

Time Test relationships were significant at the 2 per cent level and the Hoffman Schedule relationships with the tests of intelligence were insignificant.

The Otis Self Administering Test of Mental Ability, Intermediate Form, was used as the verbal intelligence test and the Goodenough Draw-A-Man Test was used as the non-language intelligence test. The difference between the mean *IQ* of 98.77 on the Goodenough and the mean *IQ* of 86.37 on the Otis was significant at the 1 per cent level of confidence. There was an inverse relationship between performance on the Otis test and knowledge of Spanish and, conversely, there was a tendency for those subjects who had a greater knowledge of Spanish to achieve higher scores on the Goodenough test. The Otis scores were more similar to the Goodenough scores for those individuals who had fewest responses on the Reaction Time Test of Bilingualism.

The investigator concluded that measuring the intelligence of bilingual subjects presents so many complex problems that the results on verbal and on non-verbal intelligence tests of the types used in this study are open to question. It is of note, however, that the students who had a greater knowledge of English, which is the language of the culture and the language of instruction at school, made significantly higher scores on the verbal test of intelligence.

Keston and Jiminez (21) gave Form M of the Stanford-Binet Intelligence Test to a random sample of 50 Spanish-American children drawn from the fourth grade in five different schools of Albuquerque, New Mexico. A month later, Form L of the Stanford-Binet in a Spanish translation was administered to this same group. All tests were given by a bilingual examiner who spoke Spanish natively. The bilingualism was determined by the qualitative judgment of the examiner through personal interview. The subjects, 22 boys and 28 girls, ranged in age from 9 years, 3 months to 11 years, 9 months with an average age of 9.85 years.

The mean *IQ* on the Form M English version was 86.0 with an *SD* of 15.3, and the mean *IQ* on the Spanish version Form L was 71.8 with an *SD* of 9.9. A correlation coefficient of .36 was found between the *IQ*s obtained on these two versions, whereas Terman and Merrill report a correlation of .93 between Forms M and L of the Stanford-Binet. The difference between the means was statistically significant. The authors attribute this difference to the fact that the level of development of the English language used by the children tested was higher than that of the Spanish language that they used. These children received their formal education in

the English language and, inasmuch as the Stanford-Binet reflects the educational achievement of children, it could be expected that higher scores would be obtained in the language which was more highly developed in formal aspects.

A number of factors in the course of testing supported this interpretation. It was the examiner's impression that these children had speech habits of preschool children in Spanish conversation. Usually the answers to the Spanish version were given in English, indicating that the immediate reaction was to answer in English. It was suggested that the development of the Spanish language was brought practically to a standstill when the child entered school and began formal education in English.

On the other hand, the English form of the test presented difficulties. Such words as *alike*, *different*, *before* and *after* gave trouble, and suggested that even the English version of the Stanford-Binet did an injustice to these bilingual children who gave evidence of confusion in language habits in a bilingual situation.

It was noted that only seven children performed better on the Spanish test than on the English test. Of these, four scores were among the five lowest on the English test, two fell in the lowest 25 per cent and only one was near the average of the group. The authors interpreted these findings to suggest the possibility that the students who performed better in the Spanish test were of low ability and had not progressed well in their formal training in the school situation. They concluded that, because of the quality of the Spanish spoken in this area by these children, the Spanish translation of the Stanford-Binet which was used for this research was not suitable, and a translation better adapted to this region or the development of another intelligence test was recommended.

Knapp (23) tested the hypothesis that "the intelligence-test scores of a Mexican immigrant sample obtained under test conditions of speed would be relatively more depressed as compared with their scores under power conditions than would the test scores of American subjects" (p. 19). The Cattell Culture Free Test, Forms 2A and 2B, was administered to 100 adult-male Mexican-visa applicants of Spanish or Indian descent and to 100 American males taken on a voluntary basis from job applicants of a large aircraft company. The mean *CA* of the Mexicans was 27.3 years with a range from 14 to 50 years, and the mean *CA* of the Americans was 31.4 years with a range from 18 to 60 years. There was a wide diversity of occupation in each group, but the largest occupational category of the Americans was that of

skilled labor, while 31 per cent of the Mexicans were classified as field workers and 15 per cent as unskilled laborers of various types.

The test instructions were translated into Spanish and put on magnetic tape. Instructions were given to both groups by means of a tape recorder, and additional help was given, when needed, by the investigator by repeating phrases from the instructions. The subjects were given the test under the two testing conditions of speed and power respectively, and their test scores were subjected to an analysis of variance. The speed conditions were the test conditions of speed upon which the norms for the test were based. The results indicated that while both groups scored higher under conditions of power than under conditions of speed, the differences were significantly greater for the Mexicans than for the Americans. The mean *IQ* of the Mexicans under the conditions of speed-power during the first session was 53 and during the second session, 81; while the mean *IQ* of the Americans under speed-power conditions was 95 during the first session and 114 during the second session. However, under the conditions of power-speed, the mean *IQ* of the Mexicans during the first session was 78 and during the second session, 66; while the mean *IQ* of the Americans under power-speed conditions was 119 during the first session and 110 during the second session.

Though the Mexican subjects received scores well below those of the Americans, the investigator stated that the available data did not substantiate the hypothesis that the lower scores were due to differences in intellectual levels of the two groups rather than cultural differences (p. 19). He added that the groups could not be considered as random samples from their respective cultures and that the results of the study must, therefore, have a limited application.

The study is, however, one of the few in the literature which have been sensitive to the effect of intelligence tests with time-limits on the scores of bilingual subjects, and the results indicate the need for further research related to this aspect of the problem of bilingualism.

D. STUDIES OF WELCH-ENGLISH BILINGUALS

The study of bilingualism in Wales is of particular importance since, according to the latest census, nearly a third of the population speaks Welch. Moreover, the Central Advisory Committee on Education in Wales suggests that the primary school should use Welch as its medium of instruction and that English should not be taught formally until the child has left the primary school (15).

The effect of bilingualism on the measurement of intelligence has not been

resolved, however, though investigations of the problem have been conducted in Wales since 1922 (see 12, 19 for a review of the earlier studies). These earlier studies made no attempt to determine the degrees of bilingualism of the subjects studied and used verbal tests only to measure intelligence.

From 1933 to 1950 non-verbal as well as verbal tests of intelligence were used and the results suggested that bilingual Welch children were at a disadvantage when measured by verbal tests of intelligence, but were not always at a disadvantage when non-verbal tests were employed.

In the past decade a greater number of Welch investigators have employed objective techniques to determine the degrees of bilingualism and the socio-economic status of their subjects. A representative number of studies which have attempted to control one or both of these variables will be reviewed in this section.

Jones (17) studied 117 children, who attended the senior classes of five schools in Caernarvonshire, to determine whether the performance of Welch-speaking children on a non-verbal test of intelligence administered in Welch would differ significantly from their performance on a verbal intelligence test in English.

The subjects ranged in age from 10 years, 2 months to 12 years, 0 months and attended schools in which more than 98.4 per cent of the children were Welch-speaking. English, as a medium of school instruction at the end of the primary grades, however, "occupies a place of almost equal importance with the mother tongue" (p. 116). The socioeconomic categories of the subjects were estimated on the basis of "a standard classification."

The Jenkins Scale of Non-Verbal Mental Ability was used to measure non-verbal ability while the Moray House Intelligence Test was used as the verbal test. In addition, the scores on Schonell's Graded Reading Vocabulary and Watts-Vernon Silent Reading Test were combined to give an individual reading age for each subject. The instructions for the non-verbal test were given in Welch; whereas, all three of the other tests are constructed in English and were given with instructions in English.

In four of the five schools the differences between the mean non-verbal *IQs* were significantly higher than the mean verbal *IQs*. These differences in favor of the non-verbal test, held also when all five schools were considered together. In all five schools the differences tended to decrease as the reading age increased. The author questioned the validity of the *IQs* on the verbal test for these subjects because of their lack of facility in English. There were no significant differences between schools with respect to intelligence, but some of the schools were significantly superior in English reading. Jones

attributed this superiority to better teaching, to better socioeconomic conditions, or to a combination of the two factors.

Jones (18) reported testing two random groups of children between the ages of 10 and 12 years from an English-speaking area and a Welch-speaking area of Caernarvonshire in order to determine the influence of reading ability in English on the intelligence-test scores of Welch-speaking children. There were 64 monoglots and 51 bilinguals in the groups tested, and answers to a questionnaire similar to the Hoffman Bilingual Schedule were used to classify the children linguistically.

The Jenkins Scale of Non-Verbal Ability was given in English to the monoglots and in Welch to the bilinguals. The Moray House Intelligence Test was used as the verbal test of intelligence and Schonell's Silent Reading Test was also administered.

No significant differences were found in the mean non-verbal *IQ*s nor were there any significant differences in variability of scores on the non-verbal test. On the verbal test of intelligence there was a significant difference of 10.63 points of *IQ* in favor of the monoglots.

The mean difference in reading ability was found to be 7.90 points in favor of the monoglots. In order to determine whether the difference in verbal intelligence remained significant if the two groups were equated in reading ability, the verbal intelligence-test scores were adjusted to a common reading basis by the method of analysis of covariance. The superiority of the monoglot group was thus reduced from 10.63 to 6.27 *IQ* points, but this residual difference remained highly significant.

Jones concluded that the results suggested that some factor or factors other than ability to comprehend material in English accounted for the significant difference in verbal intelligence. Answers to the questionnaire indicated that the bilingual children had very little opportunity to use English actively out of school, and that the teaching of English as a second language in school took place in a passive rather than an active situation, which made it difficult for them to think in English. He emphasized the necessity of considering these results tentative until further studies concerned with the nature of bilingualism and its relationship to the efficiency in thinking are made.

Jones (19) reported his investigation of the data from the 1951 Bangor study of 2,586 pupils who were classified into four linguistic groups on the basis of a language questionnaire and the estimates of headmasters. The groups were designated as Welch, Mixed-Welch, Mixed-English, and English. A classification of occupations was made with an instrument described as similar to the Maternity Inquiry of Great Britain.

The results indicated that the English and Mixed-English groups had a far greater incidence of occupations in the salaried-small-employers and non-manual categories than the Welch groups, and that these occupational differences were accompanied by significant differences in average scores on non-verbal tests of intelligence, in favor of the English groups as a whole when compared to the Welch groups as a whole.

However, when the bilingual and monolingual groups were matched according to parental occupations, the difference in mean *IQ*s on the non-verbal test of intelligence was not statistically significant. Jones concluded that the difference in intelligence-test scores in the first instance was due to the lack of control of the variable of socioeconomic status, and suggested that the results of earlier Welch studies may also have been affected by not having taken into account the socioeconomic status of the subjects.

One of the more recent Welch studies which assessed linguistic background by means of a questionnaire, and compared this assessment with teachers' ratings, was conducted by Lewis (28) with 10-year-old children from 16 primary schools in South Wales. The purpose of the study was to determine the scores of these subjects on a non-verbal test of intelligence. The linguistic questionnaire was constructed along the lines of the Hoffman Bilingual Schedule and, as a result of its administration, the subjects were divided into four groups, the pattern of which was described by the investigator as one of "decreasing bilingualism or increasing Welchness." The 27 children in Group I came from homes in which only Welch was spoken, and spoke Welch to their friends always or almost always; whereas, of the 139 children in Group IV, none spoke Welch. Group II was a mixed Welch-English group of 180 subjects, and Group III was a mixed English-Welch group of 29 subjects.

The non-verbal test of intelligence used was the Jenkins Non-Verbal Scale of Mental Ability, and an alternate version of the test with all instructions in Welch was provided for all who wished to use it.

The results indicated that the mean scores of the subjects increased as the Welchness of background decreased. This was particularly evident when the mean scores of Group I and Group IV were examined. The mean score of the children who spoke no Welch was one which corresponded to eight *IQ* points higher than the mean score of those who came from homes where only Welch was spoken and who conversed with friends in Welch always or almost always. The difference between these two scores was significant at the 1 per cent level of confidence. The overall differences between the groups were significant at the 5 per cent level of confidence.

Lewis concluded that the disadvantage which these bilingual 10-year-old children suffered on a non-verbal test of intelligence may have been attributed to the fact that they were penalized on a timed test. Furthermore, there was no provision made for appraising the socioeconomic status of the groups in this study; the groups were not equated with respect to urban-rural background, and the test used required some verbal understanding.

Morgan (30) was one of the first of the Welch investigators to use an objective and qualitative measure of the degrees of bilingualism, and to compare them with performance on non-verbal tests of intelligence. He used the Welch Language Background Scale, Raven Progressive Matrices of 1938, Daniel's Figure Reasoning Test, and the Non-Verbal Test No. 2 of the National Foundation for Educational Research to test 648 children aged 10 to 12 years in 29 schools in Mid and South Wales.

The results indicated that the influence of the language background on non-verbal tests of intelligence was greatest among the subjects whose bilingualism measured 70-99 per cent on the Welch Language Background Scale. Children with predominantly Welch-speaking backgrounds tended to receive lower scores on all tests even when the test instructions were given in the language most familiar to the child. Of the several non-verbal tests administered, the Raven Progressive Matrices, which was the only untimed test of the group, proved to be the most independent of Welch background and also the most reliable measure of non-verbal intelligence.

The investigator did not consider any of the tests used satisfactory measures for testing Welch-speaking children if the results were to be compared with those of English-speaking children for placement in schools. In looking at Morgan's results, one may again question the benefit to be derived from translating test instructions to the dominant language of the children to be tested, if that language is not the medium of instruction in school.

E. STUDIES OF OTHER BILINGUAL SUBJECTS

In addition to the studies of Spanish-English and Welch-English bilinguals reviewed in the previous sections of this article, the following investigations of other bilingual populations seemed worthy of inclusion because of the types of bilinguals studied, the variety of instruments employed to measure intelligence, and the efforts made to control one or more variables which might effect the intelligence-test results.

Cooper (9) studied a selected sample of fifth-grade bilingual children in Guam in order to determine the ability of six intelligence tests to predict school achievement. The two languages spoken by the subjects were English

and the local language, Chamarrros. While only English was spoken in the classroom, it was used infrequently on the playground and rarely at home or in the community.

The California Test of Mental Maturity, 1950 S Form, Elementary; the Davis-Eells Games, Intermediate Level; and the Culture Free Intelligence Test, Scale 2, Form A, were administered to the children in the fifth grade of four isolated villages. A stratified sample of 51 pupils selected from the larger group was given the Leiter International Performance Scale, the WISC, and the Columbia Mental Maturity Scale. The investigator chose these six tests because they are wholly or partially performance or non-verbal in nature, and the isolated villages were used in an attempt to hold the cultural factors constant.

The following results have been selected as pertinent to this review: The Columbia Mental Maturity Scale yielded the highest mean total *IQ* of 83.86, while the mean *IQ* on the California Test of Mental Maturity was 83.49. The range of total mean *IQ*s on the six tests was from 83.86 on the Columbia Mental Maturity Scale to 66.97 on the Davis-Eells Test. A mean difference of seven *IQ* points in favor of the non-language test was achieved on the California Test of Mental Maturity, and a mean difference of six *IQ* points, in favor of the Performance Scale, was achieved on the WISC.

The mean *IQ*s achieved on the three individual tests were well below those given for the standardization samples in the respective manuals. The obtained sigmas were three to four *IQ* points lower than those reported for the WISC; equal to those listed for the Columbia Mental Maturity Scale and lower than those given for the Leiter International Performance Scale.

It is evident from a study of these results that further research will be necessary to determine an intelligence test which can be administered with confidence in order to appraise the mental ability of this bilingual population. It should be noted, however, that the subjects received higher average *IQ*s on those tests which were highly non-verbal and had less complicated verbal directions.

Kittell (22) compared the language and non-language intelligence-test scores of a selected group of 83 children from one elementary school in Berkeley, California. There were 42 children (24 boys and 18 girls) in the bilingual group and 41 children (30 boys and 11 girls) in the unilingual control group.

The bilingual group included all the children, who had been in the upper half of the third grade between the fall semester of 1953 and the spring semester of 1957, whose parents had stated that one or more foreign languages

were spoken at home instead of, or in addition to, English. The control group consisted of all the children, in the third grade during one semester chosen at random between the fall semester of 1953 and the spring semester of 1957, whose parents did not indicate that a language other than English was spoken at home. The mean *CA* of the bilingual group was 104.05 months, while the mean *CA* of the control group was 104.39 months.

Fifteen different languages were represented in the bilingual group, but more than 35 per cent were in the Chinese and Japanese categories. The degree of mastery of English varied within the group.

Data on the occupations of the parents of both language groups were based on information supplied by the school records, and were interpreted by applying Warner's Revised Occupational Rating Scale. The bilingual group was classified also on the basis of parents' birthplace.

The California Short Form Test of Mental Maturity, 1953 S Form, and the California Reading Test, Primary Form AA, were administered during the second month of the child's attendance in the upper half of the third grade.

The results indicated that the control group's mean language *MA* was significantly greater than that of the bilingual group, but there was no significant difference in the mean *MA*s of the two groups on the non-language test. There was no significant difference between the mean *MA*s of the bilingual group on the language and the non-language tests, but the mean *MA* of the control group on the language test was significantly greater than its mean *MA* on the non-language test.

Occupational ratings of the parents within each language group did not have a significant effect on the mean language *MA*s, but occupational status did have a significant effect on the mean *MA*s when the two language groups were compared. The children of the unilingual group whose parents were in the middle occupational category made significantly higher scores on the language test than did the children in the bilingual group whose parents were in the middle or lower occupational categories. The factors of sex, *CA*, or parents' place of birth did not account for the differences in the language and mental-maturity scores of the two groups.

The author concluded that *IQ* scores or general *MA* scores may be misleading when testing a bilingual population, and that socioeconomic status should be considered as a factor which may be related to the effect of bilingualism on the measurement of intelligence.

Kolaska (24) made a study of 237 bilingual Polish-American high-school and college students. Four independent variables were noted and measured: Bilingual background was appraised by the Hoffman Bilingual Schedule;

socioeconomic status by the Sims Score Card for Socioeconomic Status; bilingual achievement by the Polish Vocabulary Test and the level of intelligence by the Q Subtest of the A.C.E. Psychological Examination. The dependent variable was the performance on the L Subtest of the A.C.E. Psychological Examination.

The relationship of each variable to the others was analyzed through the use of the analysis of variance. The null hypothesis of no difference between high and low bilinguals was tested and, in addition, the intercorrelations among all variables were found.

A highly significant relationship was found between the scores on the Q Subtest of the A.C.E. and performance on the linguistic-type L Subtest of the A.C.E. Neither socioeconomic status nor degrees of bilingualism influenced performance on the L test and those individuals who were highly bilingual did neither better nor more poorly than those who were moderately bilingual.

The author concluded that neither aspect of bilingualism at the high-school or college level seemed to influence performance on a linguistic type of intelligence test. Few investigators have attempted controlled studies of the problem of bilingualism and its effects on performance on intelligence tests of a linguistic type at the higher educational levels. The findings of this study substantiate some earlier studies (35, 42), but they are not in agreement with the findings of others (13, 40).

Levinson (26) compared the performance of bilingual and monolingual native-born Jewish preschool children of traditional parentage on four intelligence tests to determine the test or test items which would be most suitable for appraising the intelligence of the bilinguals. The Stanford-Binet Scale, Form L, the Wechsler Intelligence Scale for Children, the Progressive Coloured Matrices, and the Goodenough-Draw-A-Man Test were administered to 57 monoglots and 60 bilinguals in two sittings in counterbalanced order.

Each language group ranged in *C.I.* from five to six years and, when classified as to fathers' occupations according to the U.S. census data, it was found that in both groups a little more than a third had fathers in the "professional, technical and kindred workers" category; a little over one-third had fathers in the category of "craftsmen, foremen and kindred workers"; and 28 per cent had fathers in the "clerical, sales and kindred workers" category.

The results indicated that there was no correlation between intelligence and socioeconomic background in either group. Significant differences at the 5 per cent level of confidence were found between the mean scores of the

bilinguals and the monoglots on the Stanford-Binet and the WISC Full Scale, and on the WISC Verbal and Performance Scales considered separately. These differences were, in all instances, in favor of the monoglots. The differences in mean scores achieved by the two groups on the Goodenough and the Progressive Matrices were not statistically significant.

A study of the subtest results on the WISC showed that the Information, Comprehension, and Similarities subtests on the Verbal Scale; and the Picture Completion, Block Design, and Object Assembly on the Performance Scale were "fair tests" (p. 77) for the bilingual subjects. It was suggested that they be prorated and used to determine the *IQ* of comparable bilingual populations.

It should be noted in examining the results of this study that both language groups were fairly closely matched as to paternal occupations, and that the economic categories were the three upper categories of the occupational scale. The monoglots surpassed the bilinguals, however, on the verbal tests of intelligence and on one of the three performance tests.

F. SUMMARY

1. Studies of Spanish-English bilinguals in the southwestern United States and in New York City in the past ten years have indicated that bilingual subjects received significantly lower scores on verbal tests of intelligence than on non-verbal intelligence tests of the group type (11), and on non-verbal tests of the individual type (16). Bilingual subjects received significantly lower scores than monolingual subjects on verbal subtests of individual intelligence scales (1), and on individual intelligence tests of the performance type (4). In some studies the translation of the directions of intelligence tests from English to Spanish did not improve the test scores of bilingual subjects (2, 23), while in another investigation, in which the subjects had received several years of formal education in English and had a poor knowledge of Spanish, mean scores on the English version of the intelligence test were significantly higher than were mean scores on the Spanish translation of the test (Keston & Jiminez, 1954). When the socioeconomic categories of bilingual and monolingual subjects were not matched, the monoglots received significantly higher scores on verbal tests of intelligence (1) and on non-verbal tests of intelligence (4, 23). When bilinguals and monoglots were matched for socioeconomic status, their mean scores on a non-verbal test of intelligence did not differ significantly (8). Intelligence tests with time limits tended to depress the scores of adult bilingual subjects more than they depressed the scores of adult monolingual subjects (23).

2. Investigations of bilingual Welch children in the past decade have indicated that their mean scores on verbal tests of intelligence were significantly lower than their mean scores on non-verbal intelligence tests (17, 18). When the scores of bilingual and monolingual Welch children were compared on verbal tests of intelligence, the monoglots were found to have significantly higher mean scores. This difference, in favor of the monoglots, remained significant when the two language groups were equated for reading ability in English (18). Bilingual Welch children received significantly lower mean scores than the monolingual Welch children when the test instructions were given in the language most familiar to the child (28, 30). However, when the language groups were matched for socioeconomic status, no significant differences were found between the mean scores of the two groups on non-verbal intelligence tests (19). Untimed intelligence tests proved more independent of Welch background and were found to be more reliable measures of the intelligence of Welch bilingual children (30).

3. While the majority of the studies related to the effect of bilingualism on the measurement of intelligence have been conducted within the past decade on Spanish-English bilinguals in the United States, and on Welch-English bilinguals in Wales, there are, in addition, a few studies of other bilingual populations which are considered pertinent to this review.

Bilingual elementary-school children in Guam received mean *IQs* on six intelligence tests which were well below the norms given for the standardization samples in the respective manuals of the tests. However, the subjects received higher mean *IQs* on those tests of the six administered which required minimal understanding of English to follow the test directions or which were highly non-verbal in nature (9). A bilingual population in California which represented 15 different language groups, received significantly lower mean *MA*s than comparable monoglots on a verbal test of intelligence. However, no significant difference was found between the mean *MA*s of the two language groups on a non-language intelligence test. Occupational categories of parents had a significant effect on the mean *MA*s when both language groups were compared, but occupational categories did not have a significant effect when mean *MA*s were compared within each language group (22). In a study of high-school and college Polish-American bilinguals (24), it was found that neither degrees of bilingualism nor differences in socioeconomic status had a significant effect on scores achieved on a verbal test of intelligence. Those subjects who were highly bilingual did neither better nor more poorly than those who were moderately bilingual. The scores on four intelligence tests were compared for bilingual and monolingual native-born Jewish pre-

school children of traditional parentage (26). The language groups were fairly closely matched with regard to parental occupational categories and *CA*. No relationship was found in either group between paternal occupation and intelligence. Significant differences in favor of the monoglots were found between mean scores achieved in the Stanford-Binet and the WISC, and between the mean scores on the Verbal and Performance Scales of the WISC, considered separately. No significant differences were found between the mean scores of the two groups on the Goodenough-Draw-A-Man Test or on the Progressive Matrices Test.

G. CONCLUSIONS

The results of the studies reviewed in this article confirm the fact that bilingualism is not uniform as to kind, and that its influence on individuals of different races and in different environments cannot be predicted without the presentation of a far-greater amount of research than that which has been offered to date. However, some of the variables which might have an effect on the scores of bilinguals on intelligence tests have been given greater consideration in the research of the past decade.

Attempts have been made both in the United States and in Wales to measure objectively and quantitatively the degrees of bilingualism of the subjects studied. Socioeconomic status has been considered, but less frequently and with less exactitude. The time factor has been found to be important in testing bilingual children, and an increasing number of investigators have become sensitive to the advantages of untimed tests in measuring the intelligence of bilingual children.

While the bulk of evidence indicates that bilingual children receive significantly lower scores on verbal intelligence tests than comparable monoglots, this inferiority does not hold if the tests are of a non-verbal type, particularly if the monolingual and the bilingual subjects are of the same socioeconomic class.

The literature concerned with the effect of bilingualism on the measurement of intelligence of high-school and college subjects is not consistent, but the one study reported in this review indicated that bilingualism at these advanced educational levels does not affect scores on verbal intelligence tests.

Another factor, which had been found to diminish the discrepancy between the scores of bilinguals and monoglots on verbal and non-verbal tests, is an increased reading facility in the second language. However, when a verbal test is translated into the vernacular, or the instructions on a non-verbal test are given in the dominant language, bilinguals do not always improve their test scores.

Though the literature on bilingualism and its relation to the measurement of intelligence is not consistent, the conflict can frequently be resolved by referring to the age of beginning the second language, the socioeconomic and cultural backgrounds of the subjects, the instruments used for measuring the degrees of bilingualism as well as verbal and non-verbal intelligence, and the methods employed in teaching the second language. The problem requires more carefully controlled research, some of which should be of a longitudinal nature, before more decisive answers can be given.

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EYELID CONDITIONING IN YOUNG AND AGED SUBJECTS*¹

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A. PURPOSE

In a recent paper, Kimble and Ost (2) reported that, with pairings of CS and UCS in eyelid conditioning, a progressive diminution of the magnitude of *unconditioned* eyeblink occurs. Later trials with the UCS alone, however, elicit blinks of much larger magnitude. This latter fact shows that the diminution appearing on conditioning trials is under the control of the CS. For this reason, Kimble and Ost refer to the process as a variety of conditioned inhibition.

At about the time the Kimble and Ost paper was submitted for publication, Braun and Geiselhart (1) reported an experimental comparison of the progress of eyelid conditioning in subjects of different ages. The most impressive of their findings was that old subjects showed very poor conditioning.

Pavlovian theory suggests that the two sets of facts just described may be related. According to this view, advancing age leads to a lowering of the "top capability" of the cortical cells. Moreover, it is assumed that stimuli whose excitatory values exceed this top capacity may occasion a "protecting inhibition" instead of excitation. This line of reasoning suggests the possibility that aged Ss may develop more inhibition during conditioning than young Ss. Inasmuch as inhibition is reported to be capable of displaying a "pathological irradiation" and decreasing the amplitude of unconditioned reflexes,² such a theory leads to the prediction that older Ss will display a greater diminution in the amplitude of the UCR than younger Ss. Thus, finally, if this process is the same as that investigated by Kimble and Ost, there should also be a greater recovery of UCR amplitude on trials with the UCS alone, following conditioning. The primary purpose of this study was to test this Pavlovian hypothesis.

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¹ This experiment was supported by a grant from the National Science Foundation (NSF-G 7079) to the senior author. The junior author was an NIMH pre-doctoral research fellow during a part of the time when the research was being carried out. We want to thank Dr. J. W. P. Ost for help with the wiring of the apparatus.

² Professor P. S. Kupalov reports data in support of this fact in materials distributed prior to the Pavlovian conference held in New York in October, 1960. We do not know of an available published account of the phenomenon.

B. METHOD

1. Subjects

Thirty-nine male Ss (18 young and 21 older) were used in the experiment. The young Ss (mean age about 20) were volunteers from introductory psychology courses who were satisfying a course requirement. The 21 aged Ss were males secured through the Durham, North Carolina office of the United States Employment Service. Their ages ranged from 62 to 75 years, with a mean of 67 years. None of the aged Ss was hospitalized at the time of the experiment, and all were able to come to the laboratory by their own means to participate in the experiment. Moreover, each gave evidence of thoroughly understanding the rather complicated instructions (see procedure section). The aged Ss were each paid \$2 for their participation in the experiment.

2. Apparatus

Except for the modifications to be noted here and in the procedure section, the apparatus employed in this study was essentially the same as that used by Dufort and Kimble (1958). For reasons to be developed shortly, the CS in the present study was the onset of either of a pair of spatially separated neon lights, located 24" directly in front of S. The intensity of either CS was about .01 apparent ft-c. The UCS was an air puff of .05-second duration delivered to the right eye of S at a pressure of 180 mm of mercury. The CS-UCS interval was .50 second, with the CS remaining on during the presentation of the UCS. Eyelid responses were recorded on a moving paper by a system consisting of a microtorque potentiometer, the arm of which was linked to a false eyelash worn by S, a Hunter Eyeblink Amplifier, and an inkwriting response recorder.

3. Procedure

Following a method developed by Ost (3), in an effort to reduce the frequency of voluntary responses,³ Ss were led to believe that they were participating in a reaction-time experiment in which the air puff served as a mild stressor. S was seated at a table in a sound-deadened chamber with

³ This procedure has turned out to be quite effective. It has the advantage of maintaining S's interest in the experiment and also of distracting him from its purpose. In this study no Ss had to be discarded as voluntary responders. The mechanically somewhat-elaborate procedure of having S respond to a stimulus which occurs after the trial is necessary to avoid a problem discovered by Ost (1961). In two preliminary procedures in which S responded either with a key depression or release to the CS, it was found that these reactions were very apt to be accompanied by an unconditioned blink which had a latency in the CR range, and could not be distinguished from a low-amplitude CR.

his chin in a chin rest. His hands and arms rested on the table; before each hand was a telegraph key fixed to the table top. *S* was instructed to rest his index fingers lightly on the response keys and to concentrate on the CS lights.

The CS light which came on in any particular trial determined which key *S* was to depress on that trial: If the right light came on, he was to depress the right-hand key; if the left light came on, he was to depress the left-hand key response to a 6-volt door buzzer which sounded .50 second after the onset of the UCS. The buzzer terminated either when *S* responded, or after .50 second, whichever occurred first. A standard electric S-1 timer was mounted between the CS lights and informed *S* of his reaction time after each trial. A parallel timer was situated outside the experimental chamber for *E*'s information; both were reset by *E* between trials. In order to preclude *S*'s concentration, and resisting blinking, on the timer during the presentation of the conditioning stimuli, the room lights were turned off automatically two, three, or four seconds (selected haphazardly) before the onset of the CS, and came on again as the buzzer terminated. Thus, the offset of the room lights served as a ready signal in the experiment. The two CSs were presented in a random order with the restriction that neither CS occurred more than twice in succession.

Following instruction and attachment of the apparatus to *S*, a series of practice trials without the UCS was administered to familiarize *S* with the procedure. These trials were continued until *S* reached a criterion of four successive correct responses (depressing the appropriate key only after the buzzer had begun sounding). No *S* required more than 10 practice trials to reach the criterion.

Upon completion of the practice trials, 60 conditioning trials were administered at haphazard intervals of 15, 20, and 25 seconds. Following each block of 10 conditioning trials, the UCS alone was presented without the warning signal after the appropriate intertrial interval. Four additional UCS-alone trials were presented at the end of the experiment, making a total of 10 such trials in all. No data are presented concerning responses made to the first five of these UCS-alone trials since nothing regular could be observed in them.

4. Measures

Responses occurring in the interval 200-500 msec after the onset of the CS were considered to be CRs. Responses of "voluntary" form were eliminated from the analysis although very few of these occurred. A 2-mm deflection

was adopted as the response criterion; this rather large value was selected because considerable baseline "noise" in the records of some of the old Ss made the records difficult to read. The stricter criterion appeared to decrease the number of difficult decisions.

C. RESULTS

Curves showing the progress of conditioning in the groups of young and old Ss appear in Figure 1, where it is quite apparent that the young Ss conditioned to a higher level than the old Ss. Evaluated for the entire 60 trials or for the last 20 trials by means of a t test, this difference in level of conditioning was significant. Respective t values were 2.43 and 2.49 which, for 37 df , are significant between the .02 and .05 levels.

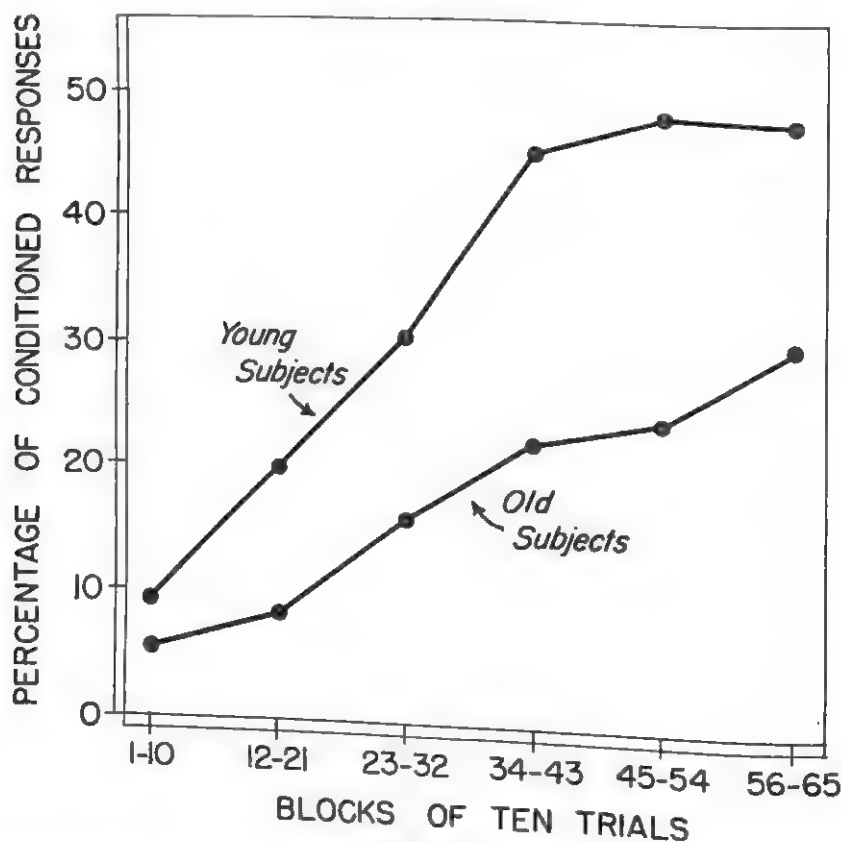


FIGURE 1
CONDITIONING IN OLD AND YOUNG Ss AS A FUNCTION OF NUMBER OF CONDITIONING TRIALS
Trials 11, 22, 33, etc., not represented in the figure, were trials with the UCS alone.

Before considering the measure of conditioned inhibition which had been hypothesized as possibly responsible for this difference, it will be well to consider other aspects of the *Ss*' responses which might be related to the differences in conditionability. In certain respects, these measures were surprisingly similar. Median amplitudes of the UCR on Trials 1-5 computed for each *S* were slightly greater for the old *Ss* than for the young ones. The two values, 15.2 mm and 14.6 mm, however, were not significantly different ($t = .42$). A similar result was obtained when a comparison was made of the median amplitude of the UCR on the last five trials on which no CRs occurred. Means of the medians of these magnitudes were 10.7 mm for the old *Ss* and 12.2 for the young *Ss* ($t = .78$).

The amount of recovery of the magnitude of the UCR on trials following conditioning, with the UCS alone, was evaluated by obtaining the differences between median UCR amplitudes on the last five trials on which no CR occurred and the first two trials without the CS. Only two postconditioning trials were used because many of the old *Ss* showed quite a rapid habituation of the UCR on these trials. Behavior on the very first such trial was exceedingly variable. Measures on the first two trials, however, provide a relatively stable measure and an optimal opportunity for differences in the degree of conditioned inhibition to appear if they exist. Even this somewhat liberal analysis, however, indicates that no differences are present. The absolute magnitude of these measures was small ($m = 0.72$ mm, $\sigma = 3.4$ mm for the young *Ss*, and $m = 0.50$ mm, $\sigma = 3.02$ mm for the old *Ss*), and the differences between them were not significant ($t = .21$). Moreover, the absolute magnitude of the increase is not significantly different from zero. This fact, which is not in correspondence with the Kimble and Ost result, we tentatively attribute to the effect of the series of interpolated UCS trials. Another possibility is that the reaction-time instructions somehow interfered with the phenomenon. It is to be noted that, with Kimble and Ost, these data indicate considerable variability in this measure, with about half of the *Ss* showing an increase and half a decrease in the amplitude of the reflex on the tests with the UCS alone.

A close inspection of the values reported above for the amplitudes of the UCR before conditioning and toward the end of the conditioning series will reveal that the old *Ss* began conditioning with a slightly stronger UCS than the young *Ss*; but that, at the end of the experiment, the UCR was weaker. In short the old *Ss*' UCRs appear to have shown a greater degree of diminution than the young *Ss*'. The respective decreases were 4.5 mm for the old *Ss*, and 2.3 mm for the young *Ss*. The difference between these two values is significant ($t = 2.06$; $df = 37$; $.02 < P < .05$).

With this demonstration of a significant difference in the degree of habituation of the UCR, these results permit two conclusions: (a) that there is a difference between the conditionability of old and young Ss, and (b) that this difference is associated with the greater degree of habituation of the UCR in the older Ss. As a further test of the second of these two conclusions, conditioning was compared for Ss who showed large and small amounts of habituation. Both groups of Ss were divided into two subgroups defined in terms of the amount of habituation of the UCR exhibited. The division was at the median of the measure of habituation. Particularly in the old Ss, these subgroups differed markedly in terms of number of CRs on the last 20 trials. The mean number of CRs was 8.20 for the group with less than the median amount of habituation; for the other group the number was 3.00. This difference was significant ($t = 2.41$; $df = 19$; $.02 < P < .05$). The trend was in the same direction in the data for the younger Ss; corresponding means were 11.89 and 7.44. In this case the difference was not significant ($t = 1.52$; $df = 16$; $.10 < P < .20$). For at least the old Ss, then, it seems safe to conclude that degree of habituation of the UCS accounts in large part for differences in the level of conditioning obtained within the group, as well as for the difference between it and the group of younger Ss.

D. DISCUSSION

The specific Pavlovian hypothesis which prompted this experiment received no support from the results. There was no difference between age groups in the extent to which the UCR recovered in amplitude on trials in which the CS was omitted. At a theoretical level, it must be concluded that no difference in the amount of conditioned inhibition has been demonstrated.

In defense of the Pavlovian theory, however, it should be emphasized that the conditions of this experiment may have been less than optimal for demonstrating differences in the "top capability of the cortical cells" of young and aged Ss. This is because the CS employed was relatively weak. According to Pavlovian theory, the chief variable controlling the potential amount of excitation delivered to the cortical cells is the intensity of the CS. It is possible that, with our weak CS, this excitation did not approach the top capability of even the least-capable cortical cells (i.e., of the old Ss) and that no appreciable amount of protecting inhibition developed in either group. Thus, no differences could have been demonstrated.

On the more positive side, this study has accomplished two things: (a) It has confirmed the results of Braun and Geiselschardt with respect to the levels of conditioning attainable with Ss of different ages. (b) It has led to the

tentative identification of one variable associated with the poor conditioning obtained with older Ss; namely, the extent to which the UCR habituates with practice.

A comparison of our results with those of Braun and Geiselschalt reveals that our aged Ss conditioned to a higher level. This, we suspect, results from the briefer UCS used in this study. In the former study UCS duration was 500 msec, whereas in this study it was only 50 msec. It seems very likely that the more protracted UCS would lead to greater habituation of the UCR than the UCS of shorter duration. Since this decrement appears to be the one factor related to poor conditioning, such an interpretation is consistent with the difference in results.

In their discussion of the inferior conditioning of old Ss, Braun and Geiselschalt proposed that, in the course of many years of living, the eyelid response of old Ss may have been "adapted out" and, thus, more difficult to condition. Our finding that poor conditioning is associated with habituation of the UCR appears to be in general agreement with this interpretation, although it might be more nearly correct to say that, with years of living, the eyelid reflex becomes more *susceptible to adaptation* and thus, to poor conditioning. In the test of reflex magnitude carried out prior to conditioning, it will be recalled, there was no evidence that the responses of the old Ss had become adapted.

E. SUMMARY

Eyelid conditioning was compared for 18 college students and 21 Ss whose mean age was 67. In correspondence with previous results the young Ss conditioned to a higher level than the old Ss. The probable reason for this is that the old Ss showed a significantly greater habituation of the UCR during conditioning.

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THE CHILD'S CONCEPTION OF HIS RELIGIOUS
DENOMINATION: III. THE PROTESTANT
CHILD*¹

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A. PURPOSE

This is the third of four papers dealing with children's conceptions of their religious denomination. Results of the first study with Jewish children (2) and of the second study with Catholic children (3) made it possible to distinguish four aspects of a denominational conception. Two of these aspects—those having to do with the property common to all members of a denomination and with the compatibility of multiple group memberships—were found to develop in three age-related stages. The other two aspects of denominational knowledge—those having to do with the recognition and attainment of denominational membership—did not reveal definite stages with age. One purpose of the present study was to determine whether similar results would be found with Protestant children.

Before going further it should be said that the study of Protestant youngsters presented difficulties not encountered in the investigations of Jewish and Catholic children. One of these difficulties was that, in contrast to the relative homogeneity of the Jewish and Catholic faiths, the Protestant faith has nearly three hundred heterogeneous groupings. In view of this diversity it was necessary to choose from among the various Protestant churches one which would be as representative as possible of the whole denomination. The Congregational Church was chosen both because of its large membership and because of its position somewhere in the middle with respect to the orthodoxy of religious beliefs and practices. The claim is not made, however, that the results of the present study correctly represent the conceptual development of all Protestant children.

The multiplicity of Protestant groups not only created a problem of sampling for the investigator, but also posed a problem of conceptualization for the Protestant children themselves. The concepts "Jew" and "Catholic" are

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first-order concepts in the sense that they have no independently named subdivisions. The concept "Protestant," on the other hand, has many independently named subdivisions and is in that sense a second-order concept—a class which includes many smaller classes. Numerous studies (e.g., 1, 5) have shown that second-order concepts are usually attained between the ages of 6–7, whereas first-order concepts are attained much earlier. Because of the inherent difficulty in forming the Protestant conception, and because Protestant children often receive less-extended and less-systematic religious training, a larger age range of subjects (5–14) was employed in this than in previous studies.

B. METHOD

1. Subjects

Three hundred Protestant children attending Sunday School of After-School Religious Classes were tested.² The children came from communities in and around Boston and varied in socioeconomic level from lower to upper class, although the majority came from middle-class homes. The mean age and standard deviation for each age group are given in Table 1.

TABLE 1
MEAN AGES AND STANDARD DEVIATIONS FOR EIGHT AGE GROUPS

<i>N</i>	Age group	Mean age	<i>SD</i> (in mos.)
20	5-6	6.0	6.20
36	7-8	8.0	7.01
32	9	9.6	2.99
36	10	10.6	3.54
24	11	11.5	3.81
53	12	12.6	3.44
57	13	13.4	3.50
42	14	14.6	2.39

2. Procedure

The 100 children who were attending Sunday-School classes were individually interviewed by the writer. The remaining 200 children were group-tested by teachers in their After-School Religious Classes. In each class, forms containing the test questions were distributed. The teachers read the questions aloud, and then requested the children to reread the questions silently and answer them in the space provided.

² The author is greatly indebted to Mrs. Gertrude Vialle (DRE) and the Sunday School teachers of the First Congregational Church of Newton, Mass., for their friendly cooperation. The author is also grateful to Rev. Walter Wyman for allowing him to test children attending Sunday School at Old South Church, Boston.

3. Interview Questions

Each child who participated in the study, whether seen individually or in a group, answered the following six questions:

1. Is your family Protestant? Are you a Protestant? Are all boys and girls in the world Protestant?
2. Can a dog or a cat be a Protestant?
3. How can you tell a person is a Protestant?
4. How do you become a Protestant?
5. What is a Protestant?
6. Can you be a Protestant and an American at the same time?

After giving their *yes* or *no* responses, children were asked to explain their answers. The explanations, rather than the *yes* and *no* answers, were the primary data of the study.

4. Scoring

According to Piaget (4) the presence of stages can be determined by the appearance of three characteristics: (a) the uniformity of response within one or several adjacent age groups; (b) the appearance of more differentiated and abstract conceptions with increasing age; (c) the presence of some ideas from the earlier stages in the generally more-advanced replies of older children (adherences) and the presence of ideas appropriate to the later stages mixed in with the generally primitive answers of the young children (anticipations). The explanations of the children in the present study were evaluated according to these criteria.

C. RESULTS AND DISCUSSION

All of the characteristics indicative of conceptual stages were found in children's replies to questions regarding the property common to all Protestants and the compatibility of multiple class memberships. Replies to the other two questions, having to do with the attainment and recognition of Protestant membership, did not show definite changes with age. In the following sections, presentation of the results which showed a stage-wise development will be followed by the results which showed no clear-cut development.

1. Knowledge of the Property Common to All Protestants (Questions 2 and 5)

The two questions to be discussed in the present section were both designed to obtain children's knowledge of the property common to all Protestants, but did so in different ways. Question 5, which asked "What is a Protes-

tant?" aimed at getting this information directly through children's definitions of "Protestant." On the other hand, Question 2, which asked "Can a dog or a cat be Protestant?" aimed at acquiring this information indirectly through children's notions of why pets could or could not be Protestant. The extent of agreement between the replies to the two questions served as an internal check of their reliability. In general the replies to both questions indicated a gradual development from vague, undifferentiated conceptions to abstract, clearly demarcated conceptions.

a. Stage 1. At this stage (usually age 5-6) children had only a vague conception of the meaning of Protestant.

Mar (5-1) What is a Protestant? "I don't know." Really? "Well, maybe it's something that makes you feel happy." Can a dog or a cat be a Protestant? "Yes." Why? "They could fight among themselves. My boy friend (sic) is a Protestant and he fights."

In her reply Mar illustrated the primitive stage in the development of the Protestant conception. She had heard the term but had not connected it with any definite property. When forced to explain the term, she chose at random from several characteristics, first saying that it "makes you feel happy" and then saying, "He is a Protestant because he fights." This first stage was characterized by a dim familiarity with the term "Protestant" and a vague and confused awareness of what the term signified.

b. Stage 2. Children at the second stage (usually 7-10) had a differentiated but concrete conception of their denomination.

Kay (8-11) What is a Protestant? "He belongs to a Protestant family." Can a dog or a cat be a Protestant? "Yes." How is that? "Sometimes they follow you to church and because it's your dog and cat."

Pete (8-4) What is a Protestant? "He gets bap-a-tized." Can a dog or a cat be a Protestant? "Yes." Why? "Because everybody in our house is Christian."

Jo (7-11) What is a Protestant? "They go to different churches." Can a dog or a cat be a Protestant? "No." Why not? "Because they don't like animals in church."

At this stage children conceived the property common to all Protestants as either (*a*) belonging to a Protestant church, or (*b*) belonging to a Protestant family. In both cases the common property was conceived concretely as a form of activity—either going to church or living in a particular house. This concrete, action-oriented conception of Protestantism was equally reflected in their responses to the question concerning the dogs and the cats. When Kay and Pete thought of the animal as part of their family, they

assumed that he partook of its properties, namely, its religious denomination. On the other hand, when Jo thought of an animal going to church, she recalled never having seen a dog in church and assumed that pets were not allowed there and therefore could not be Protestant.

c. *Stage 3.* Third-stage children (usually ages 11-14) had a differentiated and abstract conception of their denomination.

Faith (12-1) What is a Protestant? "A faithful believer in God and doesn't believe in the Pope." Can a dog or a cat be a Protestant? "No, they are God's animals, they cannot think or know God."

Will (13-1) What is a Protestant? "A person who believes in God and Christ and is loving to other men." Can a dog or a cat be a Protestant? "No, they just take the attitude of the family they are living with. We have two cats who belong to a Protestant family but it doesn't mean they are Protestant."

Laura (13-7) What is a Protestant? "A Protestant is a person who believes in Protestant things." Can a dog or a cat be a Protestant? "No, because they can't join a church or understand what God is."

As these replies indicate, children at the third stage conceived the property common to all Protestants as a system of beliefs which were both moral and religious. This new abstract conception was equally evident in their replies to the dog-and-cat question. Having attained a conception of the essential property of a denomination, understanding or belief, they also discovered the fundamental difference between animals and men, namely, intelligence. The appearance of such ideas as "belief" and "understanding" reflect a remarkable leap in the development of thought. The presence of such ideas indicates that these older children have begun to reflect on and to conceptualize their own mental processes. In this sense they have approached the level of thinking of the mature adult. The per cent of children at each stage for each question and for each age level is given in Tables 2 and 3.

2. *Knowledge of Class Membership Compatibility (Questions 1 and 6)*

Both Questions 1 and 6 forced children to judge the compatibility of two dissimilar classes. Question 1, "Are all boys and girls in the world Protestant?" aimed at revealing children's awareness of the incompatibility of certain classes (all children and all Protestants). Question 6, on the other hand, was directed towards revealing children's awareness of the compatibility of certain classes (Americans and Protestants). The two questions thus complemented each other and served as mutual checks on the reliability of the response.

TABLE 2

PER CENT OF CHILDREN ANSWERING THE QUESTION "WHAT IS A PROTESTANT?" FOR THREE STAGES AND EIGHT AGE LEVELS

N	Age group	I ^a	Stage II ^b	III ^c
20	5-6	20	5	—
36	7-8	11	39	33
32	9	9	41	34
36	10	3	33	58
24	11	—	25	75
53	12	2	32	66
57	13	2	23	75
42	14	—	5	95

Note: Seventy-five per cent of the 5-6 group, 17 per cent of the 7-8 group, 16 per cent of the age 9 group, and 6 per cent of the age 10 group gave no classifiable responses.

^a "He's nice," etc.

^b "He goes to a Protestant church," etc.

^c "He believes in one God and doesn't believe in the Pope," etc.

TABLE 3

PER CENT OF CHILDREN ANSWERING THE QUESTION "CAN A DOG OR A CAT BE A PROTESTANT?" FOR THREE STAGES AND EIGHT AGE LEVELS

N	Age group	I ^a	Stage II ^b	III ^c
20	5-6	55	20	—
36	7-8	6	91	3
32	9	3	84	13
36	10	—	83	17
24	11	—	71	29
53	12	—	55	45
57	13	—	26	70
42	14	—	12	86

Note: Twenty-five per cent of the 5-6 group, 4 per cent of the age 13 group, and 2 per cent of the age 14 group gave unclassifiable responses.

^a "Yes, 'cause they fight," etc.

^b "Yes, 'cause they belong to a Protestant family," or "No, because they are not allowed in church."

^c "No, because they don't have a mind and don't understand things like that."

a. Stage 1. Children at the first stage, usually ages 5-6, had only a vague, confused conception of class-membership compatibility.

Carl (5-0) Is your family Protestant? "No." What are they? "Actors." Are you a Protestant? "No, I'm an actor too." Are all boys and girls in the whole world actors? (Here *E* decided to go along with the child's term.) "Yes." Why? "They act nice." Can you be an American and a Protestant at the same time? "No." Why? "I don't know."

Pat (5-6) Is your family Protestant? "Our name is Blackmur." Are you a Protestant? "No," (wistfully) "just plain Blackmur." Are all boys and girls in the world Protestant? "Yes." Can you be an American and a Protestant at the same time? "Only if you move."

Lauren (6-5) Are you a Protestant? "Yes." Is your family Protestant? "Yes." Are all boys and girls in the world Protestant? "No, some are Italian." Can you be an American and a Protestant at the same time? "No." Why not? "You can't have two (names)."

These children were clearly unable to handle class inclusions and exclusions. They thought that compatible classes (American and Protestant) were incompatible and that incompatible classes (all children and all Protestants) were compatible. While part of their difficulty probably arose because of their confusion regarding the properties denoted by the conceptual terms used (as shown in the preceding section) their difficulty was probably also attributable to the logical problems involved in determining the compatibility of classes.

b. Stage 2. At the second stage (usually 7-10) youngsters had a differentiated but concrete conception of class compatibility.

Len (7-11) Are you a Protestant? "Yes." And is your family Protestant? "Yes." Are all boys and girls in the world Protestant? "No." Why not? "Some are Catholic and Jewish." Can you be an American and a Protestant at the same time? "Yes, because an American can be a Protestant or a Catholic."

Barb (9-8) Are you a Protestant? "Yes." Is your family Protestant? "Yes." Are all boys and girls in the whole world Protestant? "No." Why? "Because some of them are Catholic." Can you be both an American and a Protestant at the same time? "Yes, because you live in that world and go to that church."

These children were clearly able to make correct judgments about class inclusions and exclusions. They knew that not all boys and girls were Protestant and that they could be Protestant and American at the same time. These inclusions and exclusions, however, were explained on the concrete level of actions and observables. In justifying their answers they often referred to their own personal experiences rather than to the general properties of the classes with which they were dealing. Answers such as "You live in this world and go to this church" were concrete in the sense that they referred to particular experiences and not to the abstract qualities of the conceptions of religion and nationality. Thus correct judgments of multiple class memberships based on concrete particular experiences characterized the responses of second-stage youngsters.

c. Stage 3. Third-stage children (usually 10-14) had an abstract and differentiated conception of class-membership compatibility.

Dow (11-6) Are all boys and girls in the world Protestant? "No." Why not? "Because there are different faiths in the United States." Can you be an American and a Protestant at the same time? "Yes." Why? "Because there are different faiths in the United States."

Bert (12-5) Are all boys and girls in the whole world Protestant?
 "No." Why not? "Not all people believe in the same things." Can you
 be an American and a Protestant at the same time? "Yes." How is that?
 "In America you have the right to be any religion you want to be."

As shown by the above examples, the ability to explain the compatibility of classes by means of their abstract, general properties rather than by reference to personal experiences characterized performances of third-stage children. This finding that children's thought became objective at the third stage complements the finding of the previous section which showed that at the third stage thought also became reflective. Reflection is the objectivization or externalization of one's own thought processes. The per cent of children at each stage for each question and for each age level is given in Tables 4 and 5.

TABLE 4
 PER CENT OF CHILDREN ANSWERING THE QUESTION "ARE ALL BOYS AND GIRLS
 PROTESTANT?" FOR THREE STAGES AND EIGHT AGE LEVELS

N	Age group	I ^a	Stage II ^b	III ^c
20	5-6	75	—	—
36	7-8	3	86	11
32	9	—	81	19
36	10	—	50	50
24	11	—	42	58
53	12	—	25	75
57	13	2	18	80
42	14	—	2	98

Note: Twenty-five per cent of the age 5-6 group gave unclassifiable responses.

^a "All boys and girls are Protestant 'cause they are nice," etc.

^b "No, because some are Catholic and Jewish," etc.

^c "No, because there are other religions."

TABLE 5
 PER CENT OF CHILDREN ANSWERING THE QUESTION "CAN YOU BE AN AMERICAN AND
 A PROTESTANT AT THE SAME TIME?" FOR THREE STAGES AND EIGHT AGE LEVELS

N	Age group	I ^a	Stage II ^b	III ^c
20	5-6	50	5	—
36	7-8	6	86	8
32	9	16	72	12
36	10	—	78	22
24	11	—	27	71
53	12	—	34	66
57	13	—	28	72
42	14	—	12	88

Note: Forty-five per cent of the age 5-6 group gave unclassifiable responses.

^a "No, only if you move," etc.

^b "Yes, you can live in that country and go to that church," etc.

^c "Yes, in America there is freedom of religion," etc.

3. *Knowledge of How Protestant Membership Is Recognized (Question 3)*

For the Protestant children (as for the Jewish and Catholic youngsters) there were no clear-cut age differences observable in their replies to the question, "How can you tell a person is Protestant?" The replies were not random, however, and fell easily within one of several, easily demarcated categories. These categories and exemplars of the responses placed in them are described below.

a. Concrete religious action. Replies in this category indicated that a Protestant could be recognized by some particular, observable action.

Nor (9-2) How can you tell a person is Protestant? "The way they act." How do you mean? "You can tell by the church they go to."

b. Direct communication. In this category fell all those replies which indicated that denomination could only be determined by verbal communication.

Sue (9-6) How can you tell a person is Protestant? "You have to ask them."

c. Abstract religious action. Included in this category were all those replies which indicated that recognition of Protestant membership involved knowledge of the person's beliefs or general principles of behavior.

Fred (14-2) How can you tell a person is Protestant? "Because they are free to repent and pray to God in their own way."

Carol (12-6) How can you tell a person is a Protestant? "Because we believe different from any other religion."

d. No way. Those children whose replies fell in this category indicated that there was no way to a person's denomination.

Joe (8-6) How can you tell a person is a Protestant? "Ya can't."

e. Don't know. Children who answered that they did not know how to tell that a person was a Protestant were distinguished from those who said there was no way to tell. While on the surface the "no way" and "don't know" answers were very similar, they were really at opposite extremes of denominational knowledge. The "no way" answer implied a sophisticated understanding of religious denomination; the "don't know" answer implied a naivete with regard to religious knowledge.

It should be said that some, always the youngest children, mentioned speech and skin color as signs indicative of Protestant denomination. The context of these replies indicated that these children were confusing racial and religious characteristics. Since these replies were few in number and idio-

syncratic in quality, they were not included in the tabulation of responses shown in Table 6.

TABLE 6
PER CENT OF CHILDREN ANSWERING THE QUESTION "HOW CAN YOU TELL A PERSON IS A PROTESTANT?" FOR FIVE RESPONSE CATEGORIES AND EIGHT AGE LEVELS

N	group	DC ^a	CRA ^b	Response category		DK ^e
				ARA ^c	NW ^d	
20	5-6	—	20	—	—	80
39	7-8	23	39	15	23	—
33	9	27	27	12	22	12
37	10	35	41	19	5	—
26	11	19	53	12	12	4
60	12	13	50	22	15	—
61	13	26	28	21	25	—
47	14	23	34	26	17	—

Note: N = Number of classifiable responses.

^a Direct communication, e.g., "You have to ask."

^b Concrete religious action, e.g., "You get baptized."

^c Abstract religious action, e.g., "You believe in Protestant things."

^d No way (to tell).

^e Don't know.

4. Knowledge of How Protestant Membership Is Attained (Question 4)

Answers to the question "How do you become a Protestant?" like those presented in the preceding section fell more easily into categories than into developmental stages. The categories and typical examples are given below.

a. Family. This category included all those replies which indicated that becoming Protestant had to do with belonging to a particular family.

Mar (10-3) How do you become a Protestant? "My grandmother was and my mother and father, so I just became one."

Liz (10-8) How do you become a Protestant? "I was born into a Protestant family."

b. Concrete religious action. Under this heading were placed all those replies which indicated that becoming a Protestant was determined by some specific, clearly discernible action.

Beth (7-1) How do you become a Protestant? "By going to a Protestant church."

Bev (8-1) How do you become a Protestant? "Well, I'm not sure. Maybe if you get baptized in a Protestant church."

c. Abstract religious action. Replies indicating that becoming a Protestant involved rule-regulated or nonperceptible behaviors were included in this category.

Pat (9-9) How do you become a Protestant? "Well, you have to believe in a certain person or believe in a certain religion."

Betsy (12-5) How do you become a Protestant? "Well, you are baptized first and worship in the Protestant way and follow the Protestant rules."

Linda (10-2) How do you become a Protestant? "I learned about the religion from my parents and was baptized into the religion."

As can be seen from the above replies, some children gave answers which fell in more than one category. For this reason Table 7 gives the total number of replies rather than the number of children for each age level.

TABLE 7
PER CENT OF CHILDREN ANSWERING THE QUESTION "HOW DO YOU BECOME A PROTESTANT?" FOR EIGHT AGE LEVELS AND FOUR RESPONSE CATEGORIES

N	Age group	Fa	Response category		
			CRA ^b	ARA ^c	DK ^d
18	5-6	5	17	—	78
42	7-8	36	38	19	7
32	9	34	47	6	13
44	10	27	46	12	—
29	11	21	48	28	3
60	12	25	50	25	—
71	13	13	38	47	1
57	14	16	39	45	—

Note: N = Number of classifiable responses.

^a Family, e.g., "I was born Protestant."

^b Concrete religious action, e.g., "Baptism."

^c Abstract religious action, e.g., "You believe in Protestant things and obey the laws."

^d Don't know.

In addition to the responses categorized in Table 7, there were a few answers which were obviously idiosyncratic and derived from the unique circumstances of a particular child's life. For example, one child said that it was possible to become Protestant by "marrying a Protestant woman." Such replies were few in number and were not tabulated in the results.

While there were no clear-cut stages shown in Tables 6 and 7, some age trends were discernible. The frequency of concrete-religious-action responses at first increased and then decreased, while the percentage of abstract religious actions showed a relative increase with age. In sum, the results shown in Tables 6 and 7, like those shown in Tables 2, 3, 4, and 5, reflect a development from a vague, idiosyncratic and phenomenalistic conception to one which approached the differentiated, objective and reflective conception of mature adult thought.

5. Reliability of the Stage Categorizations

It has been suggested to the writer that the denominational studies would be of enhanced significance if some measure of reliability of the stage categori-

zations were obtained. To make as fair a test as possible, a psychologically naive but highly competent English teacher, Miss Sally Malinsky, was given a description of the criteria for the stages for each of the four questions which showed a development sequence. She then went through the records and categorized all the 300 responses to each question into three stages. A comparison of her results with those of the writer showed an agreement of better than 90 per cent for the 300 categorizations for each of the four questions. For those answers on which there was disagreement, discussion between the two raters easily resolved the difficulty. Accordingly, it can be assumed that the categorizations by stages had considerable reliability.

6. *Homogeneity of the Stages*

Until now, the presentation of results has been concerned with group trends, and individual differences have been omitted from the tabulations. The concept of stages, however, presupposes that any given child is at about the same stage with respect to all aspects of his conceptual knowledge. If this were not true it would be impossible to assume, as Piaget (6) does, that there is an underlying mental system which determines the whole of a child's conceptual performance at a given age.

To determine whether this assumption could be supported by the results of the present study, each child was given a homogeneity score. If all his answers (to the four questions which elicited responses categorizable by stages) were at the same stage, he was given an A score. If all his replies but one were at the same stage, he was given a B score. If two replies were at one stage and two at another, he was given a C score. Finally, if he gave replies at all three stages, he was given a D score. Table 8 gives the percentage of children attaining each homogeneity score for each level.

As Table 8 shows, the degree of homogeneity of response for individual children was considerable. Only 1 per cent of the children fell in the D category and only 16 per cent fell in the C category. This amount of variation could easily be accounted for by anticipations and adherences of ideas from earlier and later stages.

Table 8 also shows that the relative homogeneity of replies varied somewhat with age. This was not unexpected. Older children had passed through more stages and the possibility of adherences from earlier stages was much greater among them than among the younger children. Also at the transitional stages, when children were discarding a concrete and undifferentiated conception for a more abstract and delineated one, there was likely to be more heterogeneity of replies. All in all, the degree of homogeneity shown in

TABLE 8
PER CENT OF CHILDREN ANSWERING QUESTIONS 1, 2, 5, AND 6 FOR EIGHT AGE LEVELS
AND FOUR HOMOGENEITY-OF-RESPONSE CATEGORIES

N	Age group	Homogeneity category			
		A ^a	B ^b	C ^c	D ^d
11	5-6	83	9	8	—
36	7-8	50	41	9	—
32	9	37	47	13	3
36	10	33	39	28	—
24	11	29	42	29	—
53	12	28	44	28	—
57	13	46	44	7	3
42	14	74	19	7	—

Note: N = Number of children giving at least three responses classifiable by stages.

^a All four responses at one stage.

^b Three responses at one stage.

^c Two responses at one stage, two (or one) at another.

^d Responses at all three stages.

Table 8 is in keeping with the assumption that a common mental system underlies the conceptual performance of children at any particular age.

7. Question Difficulty

Some of the heterogeneity shown in Table 8 might have been due not to variation in the conceptual level of the children but rather to the unequal difficulty of the test questions. Using the frequency of replies at each stage as a measure, the difficulty of the questions can be roughly gauged. As shown in Table 8, Questions 2 and 6 were significantly more difficult than Questions 1 and 5. This was probably due in part to the fact that Questions 2 (Can a dog or cat be a Protestant?) and 6 (Can you be a Protestant and an American at the same time?) were more unfamiliar to children than were the Questions 1 (Are all boys and girls Protestant?) and 5 (What is a Protestant?). The unequal familiarity of the questions may therefore have played some part in producing the heterogeneity of replies from individual children, and thus reinforces the conclusion that for any given child the level of his responses tends to be homogeneous.

The results of the present investigation, like those of the previous studies in this series, are in general agreement with the developmental theory of Jean Piaget. According to Piaget, conceptions develop and the content and form of the child's verbalizations reflect the progress of this development at each age level. In the concluding paper Piaget's theory will be the starting point for a more detailed analysis of the developmental changes underlying the attainment of abstract denominational conceptions. The final paper will also

TABLE 9
FREQUENCY OF RESPONSES FOR THREE STAGES AND FOUR QUESTIONS

N	Question	I	Stages II	III
295	1 ^a	17	109	169
292	2 ^b	14	160	118
270	5 ^c	14	78	178
291	6 ^d	17	129	145
χ^2		.644	29.94*	14.21*

Note: N = Number of responses.

* Significant beyond the .01 level.

^a Are all boys and girls Protestant?

^b Can a dog or a cat be a Protestant?

^c What is a Protestant?

^d Can you be a Protestant and an American at the same time?

contain a comparison of the similarities and differences in the performances of Jewish, Catholic, and Protestant children.

D. SUMMARY

Three hundred 6-14-year-old Protestant (Congregational) children answered questions regarding their religious denomination. Results showed that the conceptualization of the property common to all Protestants and of the compatibility of multiple-class memberships developed in three age-related stages. Conceptualization of means for recognition and attainment of Protestant membership showed less clear-cut age changes. Tests for the reliability of the stage categorizations, for the homogeneity of the stages, and for the relative difficulty of the questions were included in the study. A comparison of the results with those obtained from Jewish and Catholic children, together with a theoretical treatment of all the findings, will be presented in a concluding paper.

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EFFECTS OF REPETITIOUS WORK ON PERFORMANCE OF NORMAL AND FOCAL-HEAD IRRADIATED MONKEYS*

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A. PROBLEM

Some effects of repetitious work on performance of normal and whole-body irradiated male rhesus monkeys have been studied by McDowell and Brown (2). They found that under repetitious work conditions a significantly larger proportion of control than of irradiated Ss manifested balking and that significantly more balks were shown by balking control than by balking irradiated Ss.

The present study was conducted to determine if focal-head irradiated male rhesus monkeys differ from normal monkeys in a manner analogous to whole-body irradiated monkeys under repetitious work conditions.

B. EXPERIMENTAL PROCEDURE

1. *Subjects*

Five control and five focal-head irradiated rhesus monkeys with nearly identical training histories were used as Ss in the experiment. These Ss were the survivors of a comprehensive focal-head irradiation study (1) conducted four years earlier. The five experimental Ss had been exposed at that time to focal-head irradiation with X rays.

One of the experimental Ss had received 3,000 r X-ray radiation to the brain anterior to the caudal aspect of the precentral sulcus fissure. Thirty days later he had received the same dosage to the same area of the brain. The other four experimental Ss had received equivalent dosages, with the same spacing, to an area of the head containing the inferior parietal lobule and posterior aspect of the temporal lobe.

2. *Apparatus*

All testing was conducted in a modified version of the Wisconsin General Test Apparatus with the carrying cage serving as the holding cage during

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testing. The spatial separation between the two food wells on the stimulus tray was 12 inches. The stimulus objects were a red-painted triangular wood block and a red-painted circular wood block mounted vertically on red-painted rectangular wood blocks.

3. Procedure

Each *S* was tested for 50 trials or until balking occurred each day for 44 days on the same form-discrimination problem. Response to the red triangular block was consistently rewarded; response to the red circular block was consistently nonrewarded. The noncorrection method was used. If on any trial in the daily testing a *S* refused to respond within a three-minute time limit, the *S* was accorded a *balk* and testing was discontinued for that day.

C. RESULTS

Three of the five control *S*s and four of the five experimental *S*s scored balks during the 44 days of testing. The mean number of balks by the control *S*s and by the posterior focal-head irradiated *S*s and the number of balks by the frontal focal-head irradiated *S* are shown in Figure 1. Statistical

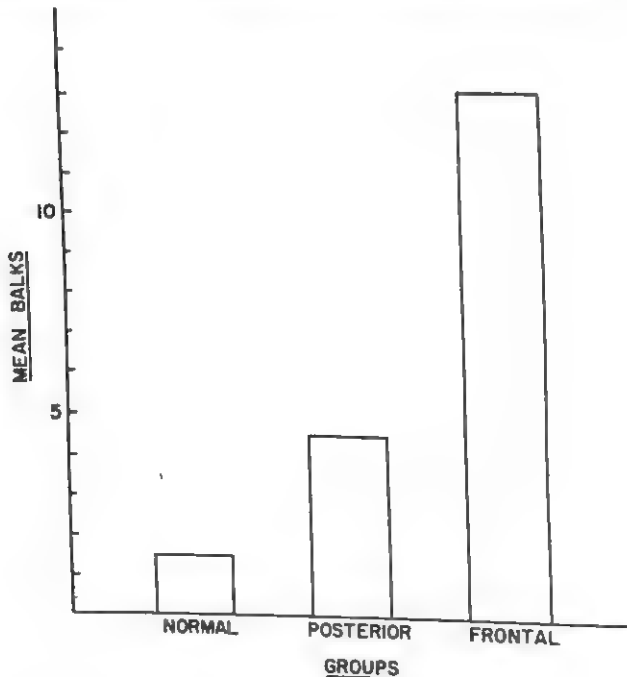


FIGURE 1
MEAN BALKS BY THE *S*s OF EACH OF THE THREE GROUPS

analysis of the data on which this figure is based yielded an F ratio for the difference between groups which was beyond the .025 significance level. The fewest balks were shown by the control-group S s. The frontal focal-head irradiated S showed more balks than any other S .

Figure 2 shows the comparison between days to learning and days to balking for all S s showing balks. Learning was defined as two successive

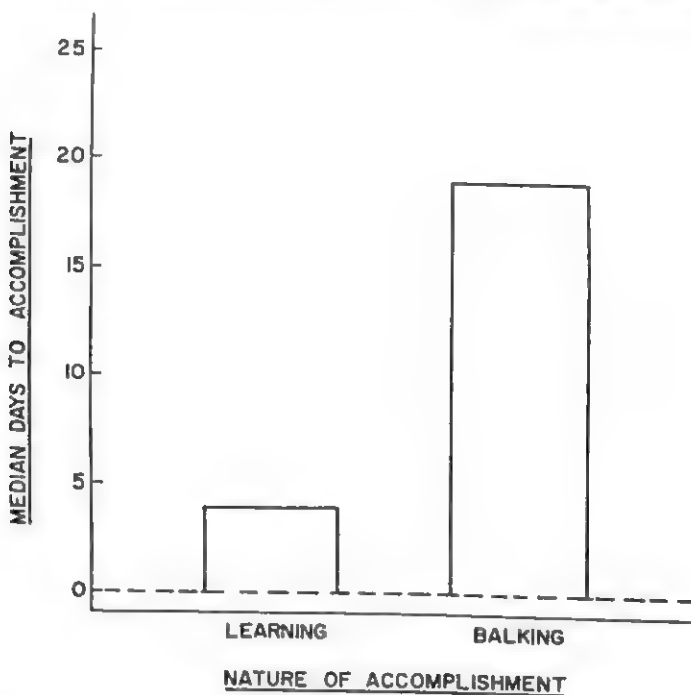


FIGURE 2

MEDIAN DAYS TO THE ACCOMPLISHMENT OF LEARNING AND OF BALKING BY BALKING S s days of errorless performance. Balking occurred later than learning with the difference being beyond the .05 significance level as measured by the Wilcoxon paired-replicates test (3).

D. DISCUSSION

The findings of the present study show that focal-head irradiated monkeys differ from normal monkeys in a converse manner than whole-body irradiated monkeys under conditions of repetitious work. The focal-head irradiated monkeys showed more, rather than fewer, balks than did their normal controls. Such data demonstrate lasting effects of focal-head irradiation with X rays, and also suggest sites of permanent damage for monkeys given sub-

lethal whole-body radiation exposure other than those of the restricted areas of exposure in the Ss of the present study.

The findings of the present study also indicate that balking under these conditions of repetitious work reflects something other than frustration induced by problem difficulty. Balking occurred significantly later in training than did the achievement of a rigid criterion of learning.

E. SUMMARY

Five normal monkeys, four monkeys with previous focal-head irradiation of the posterior association areas, and one monkey with previous focal-head irradiation of the frontal association areas were tested for 50 trials or until balking occurred each day for 44 days on a single form-discrimination problem. If any S refused to respond within a three-minute time limit at any point in the daily testing, he was accorded a balk for that day. The results of the present study showed that:

1. The Ss of the three groups differed significantly with respect to frequency of balking, the Ss of the control group showing the fewest balks and the S with previous focal-head irradiation of the frontal association areas the most balks.

2. Balking Ss took significantly longer to register balking than to achieve a rigid criterion of learning.

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SOCIAL DISTRACTIBILITY OF NORMAL AND PREVIOUSLY
IRRADIATED MALE RHESUS MONKEYS*¹

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A. PROBLEM

Harlow and Moon (2) reported, in 1956, a significant increase in performance of whole-body irradiated monkeys over that of control monkeys on both oddity problems and delayed-response tests. They suggested that the enhancement of performance by the irradiated Ss might be due, in part, to decreased distractibility. Riopelle, Grodsky, and Ades (7) reported, during the same year, superior performance by whole-body irradiated monkeys on two difficult visual discrimination tasks and suggested that this superiority in the irradiated Ss may be due to increased resistance to distraction or to increased tameness.

McDowell (3) published, in 1958, results supporting the tenability of an hypothesis of decreased distractibility in whole-body irradiated monkeys. He found, using visual and auditory stimulus conditions, that all stimulus conditions which significantly affected the performance latencies of whole-body irradiated monkeys on a simple repetitive task also significantly affected the performance latencies of normal monkeys, but that some stimulus conditions, which did affect the performance latencies of the irradiated Ss, did significantly affect the performance latencies of the normal Ss. More recently, McDowell, Brown, and Wicker (5) have shown that the higher the relative radiation dosage, the less is the increase in response latencies of monkeys when a novel, nonreinforced stimulus cue is introduced into an instrumental conditioning paradigm.

The present investigation proposed to study the effects of distraction upon free-cage behavior rather than upon specific task performance and sought specifically to determine the relationship between amount of previous whole-body radiation exposure of adult male rhesus monkeys and behavioral stability under conditions of social distraction.

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B. METHODS

1. *Subjects*

Three normal and 15 previously irradiated male rhesus monkeys, with nearly identical training histories, served as *Ss* in the initial phase of the investigation. These *Ss*, the survivors of an earlier comprehensive study of whole-body irradiation effects (1), ranged in age from nine years to 10 years when the present study was initiated. In the present study, they were grouped into four subgroups: a control group of three *Ss*, a low-dose group of six *Ss*, an intermediate-dose group of six *Ss*, and a high-dose group of three *Ss*. The dose range for the *Ss* in the low-dose group was between 10 to 16 neutron rep plus 70 to 140 gamma roentgens; the dose received by the *Ss* of the intermediate-dose group was 27 neutron rep plus 284 gamma roentgens; and that received by the *Ss* of the high-dose group was 54 neutron rep plus 554 gamma roentgens, the source including both gamma and neutron radiation. The chronic laboratory exposure of the *Ss* to radiation preceded the present study by more than six years.

Thirty male rhesus monkeys, with nearly identical training histories, were the *Ss* in the final phase of the investigation. These *Ss* ranged in age from five years to six years at the time of the present study. In this study, they were grouped into three subgroups: a low-dose group of nine *Ss*, an intermediate-dose group of nine *Ss*, and a high-dose group of 12 *Ss*. The dose range for the *Ss* of the low-dose group was from 0 to 299 rem, that for the *Ss* of the intermediate-dose group from 355 to 439 rem, and that for the *Ss* of the high-dose group from 512 to 670 rem. The acute field exposure of the *Ss* to nuclear radiations preceded the present study by approximately three and one-half years.

2. *Procedure*

The basic procedure was adapted from that of McDowell, Davis, and Steele (6) and consisted of systematic observations of the free-cage behavior of the monkey. During each observation the *S* was placed in a special holding cage. This cage measured $3 \times 3 \times 3$ feet and was constructed of steel bars placed three inches apart, center-to-center. A wooden cage bed was affixed to one side of the cage.

To record an observation the observer sat eight feet from the special holding cage and recorded on a mimeographed category sheet the nature and direction or nondirection of the *S*'s behavior every 10 seconds on the 10-second mark. Each observation was of five minutes duration and, in consequence, the total frequency count for each *S* for each observation was arbitrarily 30.

The behavioral categories on the mimeographed category sheet included (a) nondirected visual activity; (b) nondirected locomotor activity; (c) manual, oral, and visual response to the *S*'s body parts; (d) manual, oral, and visual response to the cage parts as manipulanda; (e) visual response to the experimenter; and (f) orientational response to noises occurring outside of the test room. The statistical reliability of variables of this nature has been previously demonstrated (3, 4, 6).

In the initial phase of the investigation, each *S* of the laboratory exposed group was observed once, over a three-day period, under each of three conditions of social distraction. In one condition, no social stimulus was present; in another condition, an adult female monkey at time of menstruation was present; and in the other condition, an adult female monkey at estimated time of ovulation was present. Order of condition presentation was counterbalanced over days within each radiation-dosage group. The female *S* was, in each instance, visually, but not physically accessible, being placed in a well-lighted holding cage at a distance of three feet from the cage housing the *S* to be observed. The same procedure was repeated one month later with the same experimental *S*s and, then, was replicated with the *S*s of the field exposed group.

Behavioral stability was considered in terms of the maintenance during each condition with a female *S* present of the balance between total directed activities and total nondirected activities manifest under the condition of no social distraction. Total nondirected activity was chosen as the dependent variable with which to measure that stability. Responses to the social stimuli were, also, measured by determining, for each *S*, the difference between 30 and the total frequency count during each observation with a female *S* present. Statistical treatment of each set of data utilized an analysis of variance procedure.

C. RESULTS

Figure 1 shows the mean nondirected activities of the *S*s of each of the four groups of the initial phase of the investigation under each of the conditions of observation. In Figure 1, as well as in two figures to follow, the control condition refers to the condition with no social stimulus present, the social condition₁ refers to the condition with an adult female monkey at menses present, and the social condition₂ refers to the condition with an adult female monkey at estimated time of ovulation present. Statistical analysis of the frequency data upon which Figure 1 is based yielded a difference between groups which was beyond the .025 significance level, a difference between conditions which was beyond the .001 significance level, and a

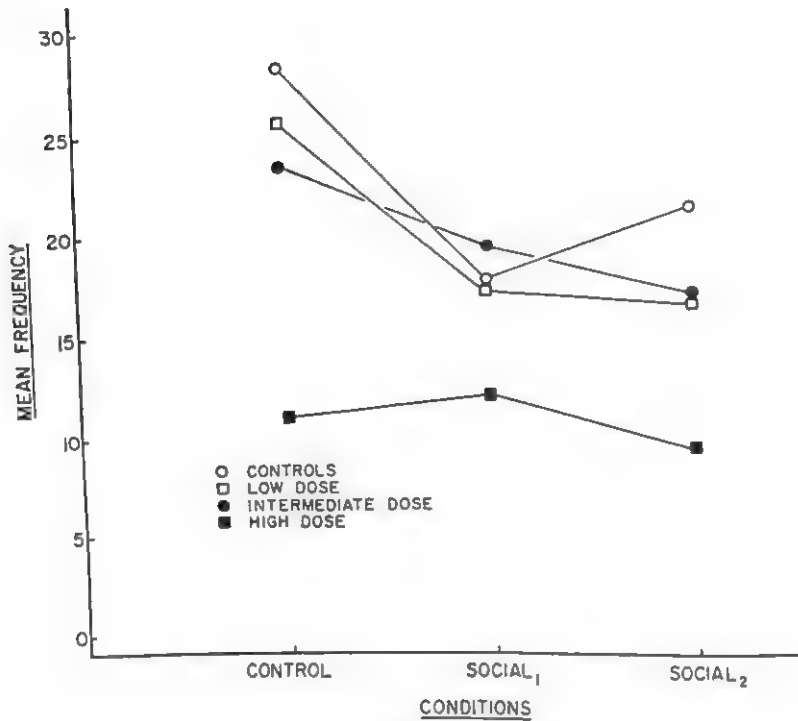


FIGURE 1

MEAN FREQUENCY DURING THE INITIAL STUDY OF NONDIRECTED ACTIVITIES OF THE Ss OF EACH OF THE FOUR RADIATION GROUPS UNDER EACH OF THE THREE CONDITIONS OF SOCIAL STIMULATION

group-by-conditions interaction which was beyond the .025 significance level. The presence of the female Ss produced a comparable decrease in the non-directed activities of the Ss in the control and low-dose groups, a relatively smaller decrease for the Ss of the intermediate-dose group, and no decrease for the Ss of the high-dose group. The groups failed to differ significantly with regard to overt responses to the female subjects.

Figure 2 shows the mean nondirected activities of the Ss of the same four groups under each of the conditions of observation when tested the second time. Statistical analysis of the frequency data upon which Figure 2 is based yielded a difference between groups which was beyond the .05 significance level, a difference between conditions which was beyond the .005 significance level, and a groups-by-conditions interaction which was beyond the .01 significance level. The presence of the female Ss, in this instance, produced effects comparable to the initial test with the same groups of Ss. Again, the Ss of the four

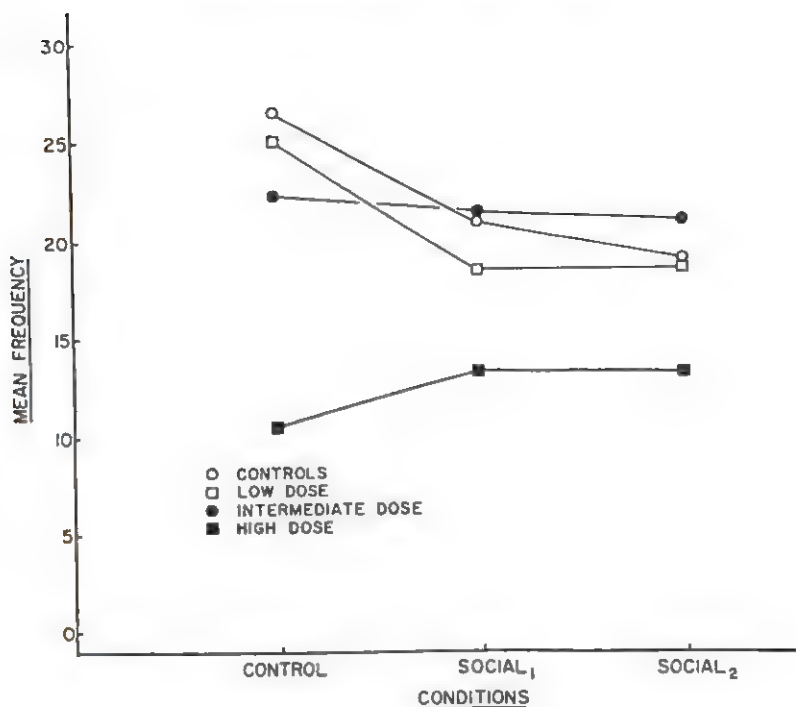


FIGURE 2
MEAN FREQUENCY WHEN RETESTED OF NONDIRECTED ACTIVITIES OF THE Ss OF EACH OF THE FOUR RADIATION GROUPS UNDER EACH OF THE THREE CONDITIONS OF SOCIAL STIMULATION

groups failed to differ significantly with regard to overt responses to the female Ss.

Figure 3 shows the mean nondirected activities of the Ss of each of the three relative-radiation-dosage groups of the replication study under each of the conditions of observation. Statistical analysis of the data upon which Figure 3 is based yielded a difference between conditions which was beyond the .001 significance level and a groups-by-conditions interaction which was, also, beyond the .001 significance level. The amount of decrease in frequency of nondirected activities produced by the presence of the female Ss was inversely related to relative radiation dosage.

Figure 4 shows the mean frequencies of overt responses to the female Ss for the Ss of the three relative-radiation-dosage groups. Statistical analysis, in this instance, yielded a difference between groups which was beyond the .025 significance level. As can be seen in Figure 4, overt responsiveness to the female Ss was also inversely related to relative radiation dosage.

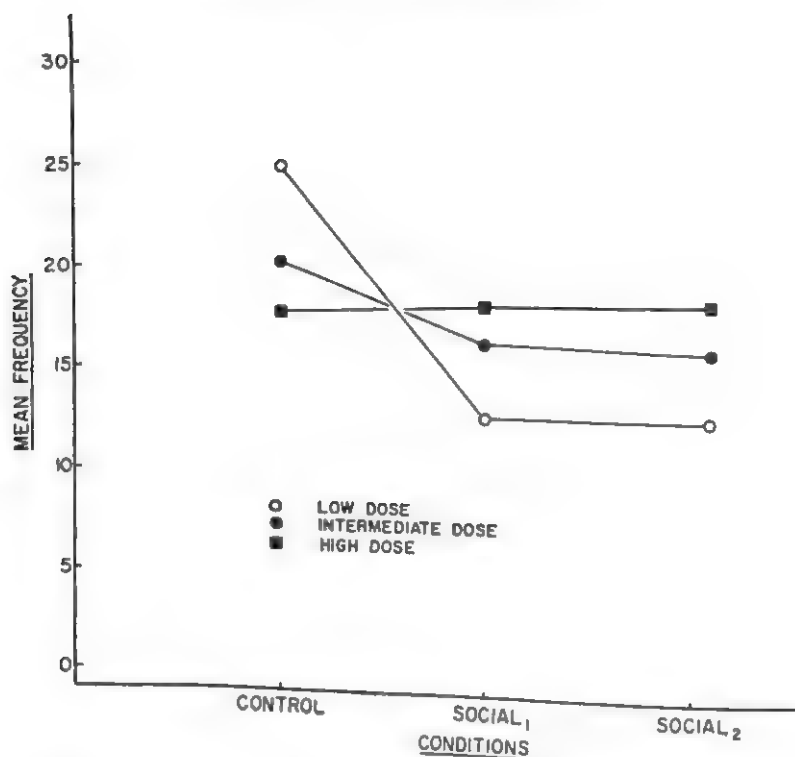


FIGURE 3

MEAN FREQUENCY DURING THE REPLICATION STUDY OF NONDIRECTED ACTIVITIES OF THE Ss OF EACH OF THE THREE RELATIVE-RADIATION-DOSE GROUPS UNDER EACH OF THE THREE CONDITIONS OF SOCIAL STIMULATION

D. DISCUSSION

The results of the present investigation clearly show an ordered relationship between amount of previous whole-body radiation exposure and disruption of social stimuli, the nature of the relationship being decreased disruption with increased radiation dosage. When, in the initial study of the investigation, of social stimuli on the amount of nondirected behavior evidenced when no social stimuli were present, nonexposed and low-dose irradiated Ss showed the greatest decrease in nondirected behavior (increase in object-directed behavior) when social stimuli were introduced, intermediate-dose irradiated Ss showed a smaller decrease, and high dose Ss showed no decrease. A retest of the same Ss one month later produced comparable results and demonstrated

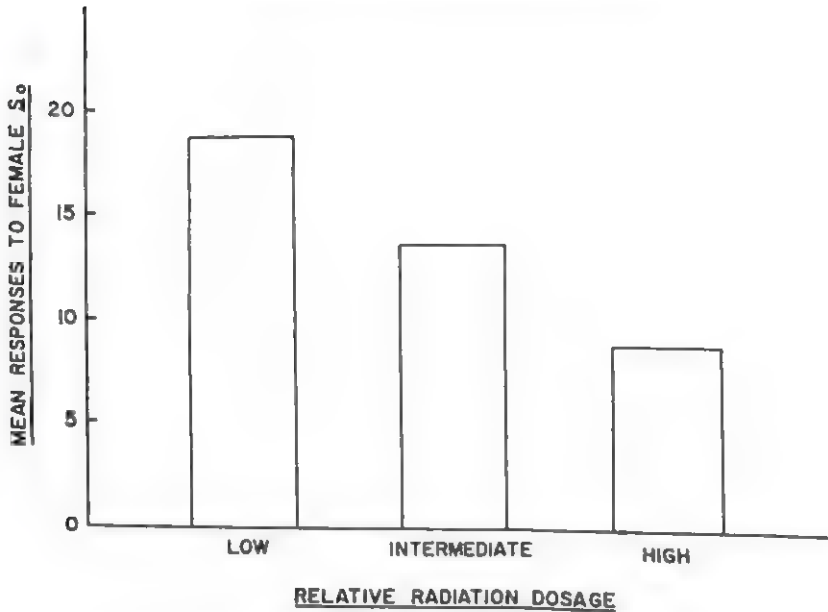


FIGURE 4
MEAN FREQUENCY OF OVERT RESPONSES TO THE SOCIAL STIMULI BY THE Ss OF EACH OF THE THREE RELATIVE-RADIATION-DOSAGE GROUPS

the stability of the relationship. The validity was established when a replication of the study with an independent group of Ss yielded similar findings.

These results are interpreted by the authors as reflecting decreased social distractibility accruing to whole-body radiation exposure and are in accord with findings of previous studies concerned with the effects of nonsocial distractions upon performance of specific laboratory tasks.

Additional results with the young Ss of the replication study show directly the effects of previous radiation exposure upon responsiveness to the social stimuli. With these Ss, overt responses to the social stimuli decreased directly with increased radiation dosage. Whether results of this nature reflect direct effects of radiation exposure upon the endocrine system of the monkey remains to be determined.

E. SUMMARY

An investigation was conducted to determine the relationship between amount of previous whole-body radiation exposure of adult male rhesus monkeys and behavioral stability under conditions of social distraction. Behavioral stability was defined in terms of the maintenance under conditions of social distraction of the balance between the directed and the nondirected

activities of the free cage behavior of the *S* under a condition of no social distraction. Total nondirected activity was used as the dependent variable to measure that stability.

In the initial study of the investigation, laboratory exposed *Ss* were each systematically observed once, over a three-day period, under each of three conditions of social distraction. One condition had no social stimuli present, a second had an adult female monkey at menses present, and the third had an adult female monkey at estimated time of ovulation present. Order of condition presentation was counterbalanced over days within each radiation-dosage group. The female *S*, was, in each instance, visually, but not physically accessible, being placed in a cage at a distance of three feet from the cage housing the experimental *S*. The study was repeated one month later with the same experimental *Ss* and, then, was replicated with field exposed *Ss*.

Statistical treatment of each set of data yielded a significant radiation groups-by-conditions interaction. Each interaction reflected a positive relationship between amount of previous whole-body radiation exposure and behavioral stability under conditions of social distraction.

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SOME EVIDENCE OF "PSYCHIC BLINDNESS" IN MONKEYS WITH FOCAL-HEAD IRRADIATION OF THE TEMPORAL LOBES*¹

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A. PROBLEM

A number of the changes in the behavior of monkeys consequent upon bilateral temporal lobectomy were reported more than twenty years ago by Klüver and Bucy (3, 4, 5, 6). They noted, among other effects, the appearance of "... forms of behavior which appear to indicate a 'psychic blindness' or visual agnosia in the sense that the ability to recognize and detect the meaning of objects on the basis of visual criteria alone seems to be lost" (2, p. 151).

The present study was conducted to compare the effects of various extra-cage social stimuli on the free cage behavior of normal monkeys and of monkeys with previous focal-head irradiation of the temporal lobes. The treatment of the results assumed that differences in kind, but not in degree, of effect could be taken as evidence of "psychic blindness" in the experimental Ss.

B. EXPERIMENTAL PROCEDURE

1. Subjects

Four control and four focal-head irradiated monkeys with nearly identical training histories served as Ss. These Ss were the survivors of a comprehensive focal-head irradiation study (1) conducted four-and-one-half years earlier.

The four experimental Ss had, during the earlier study, received 3,000 r X-ray radiation to an area of the head containing the inferior parietal lobule and posterior aspect of the temporal lobe. Thirty days later they had received the same dosage to the same area of the head.

2. Procedure

The methodology followed that of McDowell, Davis, and Steele (7) and consisted of systematic observations of the free cage behavior of the monkey.

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¹ This work was conducted at the Radiobiological Laboratory of the University of Texas and the United States Air Force and supported (in part) by Contract AF 41(657)-382 and the School of Aerospace Medicine.

During each observation the *S* was placed in a special holding cage. This cage measured $3 \times 3 \times 3$ feet and was constructed of steel bars placed three inches apart center-to-center. A wooden cage bed was affixed to one side of the cage.

During a four-day period the behavior of each *S* was systematically observed for five minutes under each of four social-stimulus conditions. Order of condition presentation was counterbalanced over days within each of the two groups. The stimulus conditions included a condition with no social stimulus, a condition with an adult male monkey, a condition with a female monkey at menses, and a condition with a female monkey at estimated time of ovulation. The social stimulus was, in each of the last three instances, visually, but not physically, accessible, being placed in a well-lighted holding cage at a distance of three feet from the cage housing the experimental *S*.

To record an observation, the experimenter sat eight feet from the cage housing the *S* to be observed, and recorded on a mimeographed category sheet the nature and direction of the *S*'s behavior every 10 seconds on the 10-second mark. Since each observation was of five-minute duration, the total frequency count for each observation under the condition with no social stimulus was arbitrarily 30. Under each of the three conditions with social stimuli, the difference between 30 and the total frequency count reflected the *S*'s responses to the social stimulus.

The categories of behavior were nondirected visual activity (characterized by predominance of visual activity without apparent fixation), nondirected locomotor activity (whether by pacing, bouncing, or swinging suspension), inanimate object-directed activity (whether by manual, oral, or visual response to the cage parts as manipulanda), self-directed activity (whether by manual, oral, or visual response to body parts), experimenter-directed activity (visual response to the experimenter), and auditory attention to sounds randomly occurring outside the test room.

C. RESULTS

The mean frequency of total nondirected activities for the *S*s of each of the two groups under each of the social stimulus conditions is shown in Figure 1. In Figure 1, as well as in the figures to follow, *N* refers to the condition with no social stimulus present, *M* refers to the condition with an adult male monkey present, *F_M* refers to the condition with a female monkey at menses present, and *F_O* refers to the condition with a female monkey at estimated time of ovulation present. Statistical treatment of the frequency data on which Figure 1 is based, using an analysis of variance procedure,

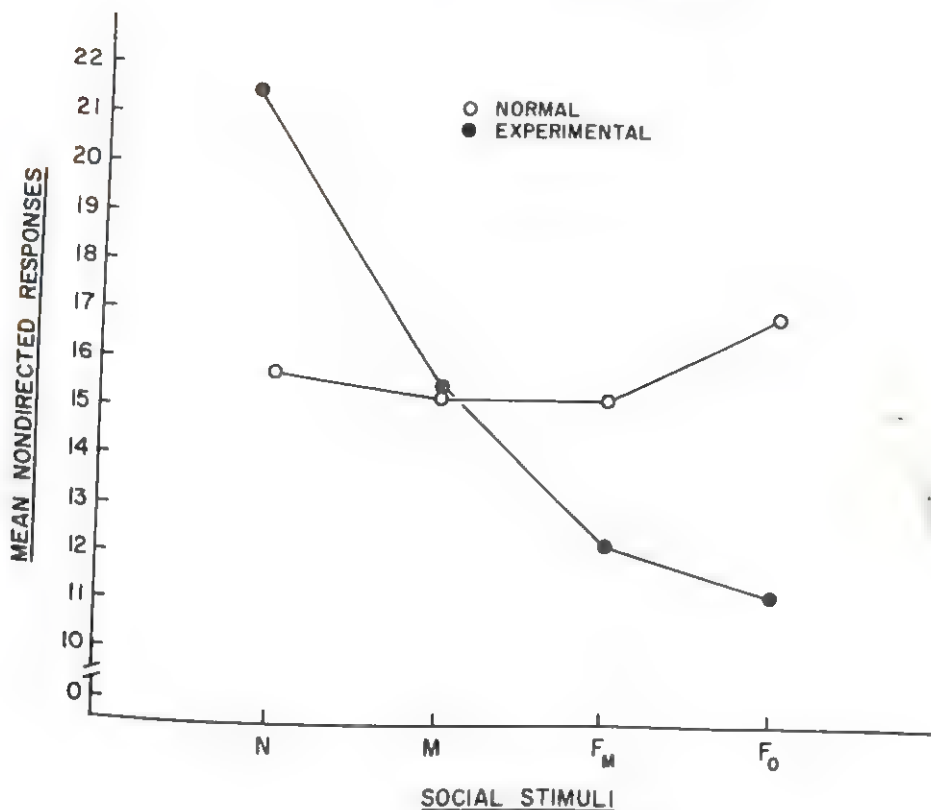


FIGURE 1

MEAN FREQUENCY OF NONDIRECTED ACTIVITIES FOR THE Ss OF EACH OF THE TWO GROUPS UNDER EACH OF THE FOUR SOCIAL-STIMULUS CONDITIONS

yielded a groups-by-conditions interaction which was beyond the .025 significance level. The Ss of the focal-head irradiated group showed a progressive decline in frequency of nondirected activities from Condition N, through Conditions M and F_M, to Condition F₀, while the Ss of the control group showed little change in frequency over the four conditions.

The mean frequency of total directed activities for Ss of each of the two groups under each of the four social-stimulus conditions is shown in Figure 2. Statistical treatment of the frequency data on which Figure 2 is based yielded a groups-by-conditions interaction which was beyond the .025 significance level. In this instance, the Ss of the control group showed a decrease and the Ss of the focal-head irradiated group an increase in frequency from Condition N, through Conditions M and F_M, to Condition F₀.

The only specific object category with respect to which directed activities

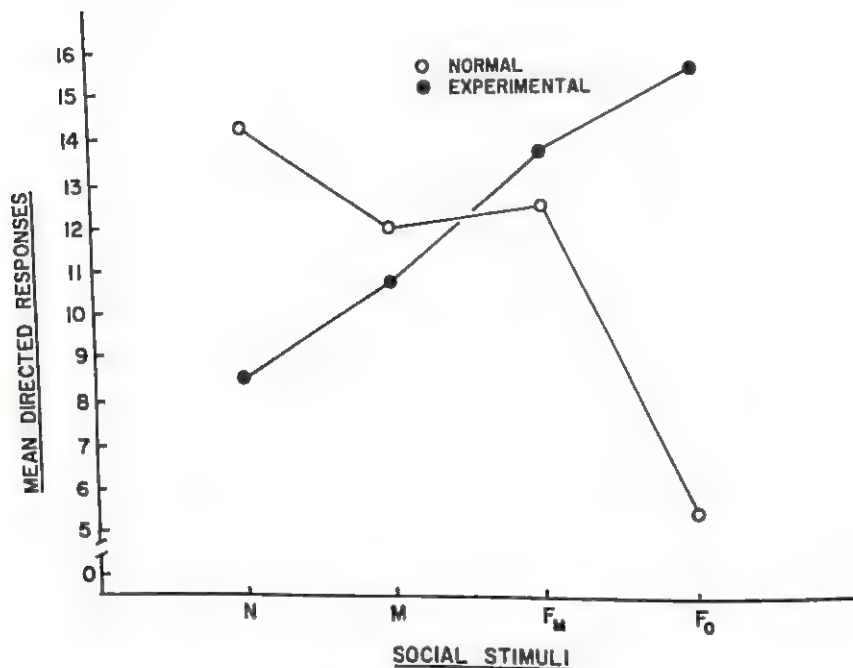


FIGURE 2

MEAN FREQUENCY OF TOTAL DIRECTED ACTIVITIES FOR THE Ss OF EACH OF THE TWO GROUPS UNDER EACH OF THE FOUR SOCIAL-STIMULUS CONDITIONS

were systematically affected was that of inanimate objects as manipulanda. Figure 3 shows the mean frequency of inanimate object-directed activities for the Ss of each of the two groups under each of the four social-stimulus conditions. In this instance, the groups-by-conditions interaction was beyond the .001 significance level and the results paralleled those with respect to total directed activities.

In Figure 4 is shown the mean frequency of response by the Ss of each of the two groups to each of the three social stimuli. Statistical analysis of the frequency data on which Figure 4 is based yielded a groups-by-stimuli interaction which was beyond the .025 significance level. The Ss of the focal-head irradiated group were equally responsive to each of the three social stimuli, whereas the Ss of the control group were selectively responsive to the female monkey at estimated time of ovulation.

D. DISCUSSION

If one assumes the propriety of response by the normal Ss to social stimuli, the data of the present study are strongly suggestive of "psychic blindness" in

the monkeys previously exposed to focal-head irradiation of the temporal lobes. It is true that the decreased frequency of nondirected activities by the focal-head irradiated Ss as contrasted with the lack of change by the control Ss under conditions of social stimulation, and the equivalent direct responsiveness of the focal-head irradiated Ss to each of the three social stimuli as con-

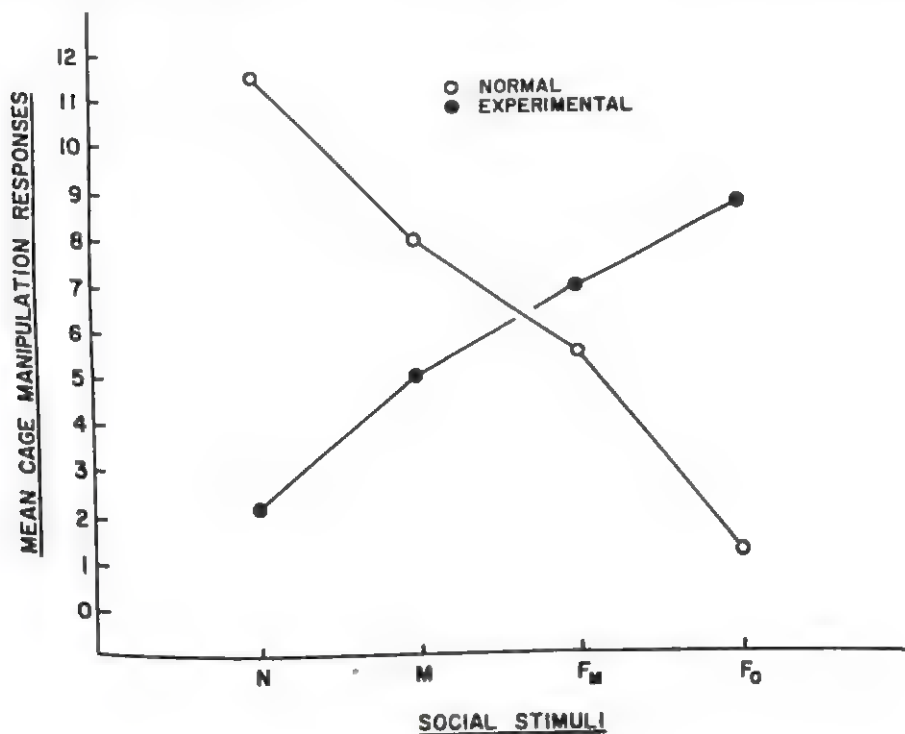


FIGURE 3
MEAN FREQUENCY OF INANIMATE-OBJECT-DIRECTED ACTIVITIES FOR THE Ss OF EACH OF THE TWO GROUPS UNDER EACH OF THE FOUR SOCIAL-STIMULUS CONDITIONS

trasted with the heightened direct responsiveness of the control Ss to the female at estimated time of ovulation, reflect only differences in degree of effect and do not bear on the issue. The increased frequency of response to the cage parts as manipulanda by the Ss of the focal-head irradiated group under conditions of social stimulation, as contrasted with the decreased frequency of similar response by the Ss of the control group under the same conditions, however, argues inappropriateness of response for the focal-head irradiated Ss and is considered as evidence of some degree of "psychic blindness" for these Ss.

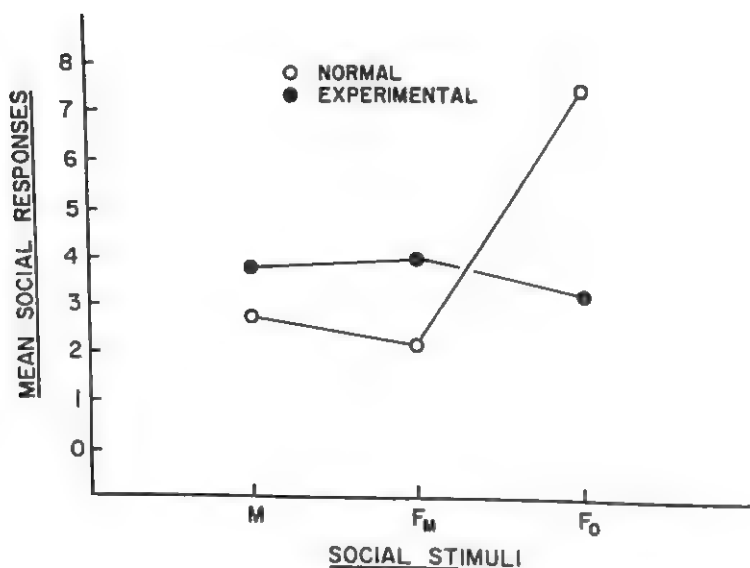


FIGURE 4
MEAN FREQUENCY OF RESPONSES BY THE Ss OF EACH OF THE TWO GROUPS TO EACH OF THE THREE SOCIAL STIMULI

E. SUMMARY

Four normal adult male monkeys and four adult male monkeys that had received focal-head irradiation of the temporal lobes more than four years earlier were each systematically observed under each of four social-stimulus conditions with the order of condition presentation counterbalanced within each group over a four-day period. The four social-stimulus conditions included absence of social stimulus, an adult male monkey, an adult female monkey at menses, and an adult female monkey at estimated time of ovulation. The effects of the social-stimulus conditions upon the free cage behavior of the Ss of the two groups were as follows:

1. The social-stimulus conditions showed no effect on the nondirected activities of the normal Ss, but produced a marked decrease in the non-directed activities of the focal-head irradiated Ss, with the least number of such activities being manifest in the presence of the adult female monkey at estimated time of ovulation.
2. Under conditions of social stimulation, the normal Ss showed a marked decrease in total directed activities of the no-social-stimulus condition, while the focal-head irradiated Ss showed a marked increase, the effect in each in-

stance being greatest in the presence of the female at estimated time of ovulation.

3. The specific object category with respect to which the directed activities of the control Ss decreased and those of the experimental Ss increased was that of inanimate cage parts as manipulanda.

4. The control Ss were more than twice as responsive to the female at estimated time of ovulation as to the other two social stimuli, while the experimental Ss were equally responsive to each of the three social stimuli.

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RESPONSE LATENCIES OF NORMAL AND FOCAL-HEAD IRRADIATED MONKEYS*¹

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A. PROBLEM

Response latencies of normal and whole-body irradiated rhesus monkeys under both familiar and novel stimulus conditions have been studied by McDowell, Brown, and Wicker (3). They found that the higher the relative radiation dosage the longer was the response latency to a single, familiar, stimulus cue and that the higher the relative radiation dosage the less was the disruption of response latency when a novel, nonrewarded, stimulus cue was introduced into the situation.

The present study proposed to determine if focal-head irradiated rhesus monkeys differ from normal monkeys in a manner analogous to whole-body irradiated monkeys with respect to response latencies under both familiar and novel stimulus conditions.

B. EXPERIMENTAL PROCEDURE

1. Subjects

Five control and four focal-head irradiated rhesus monkeys with nearly identical training histories were used as Ss in the experiment. These Ss were the survivors of a comprehensive focal-head irradiation study (1) conducted four years earlier. The four experimental Ss had been exposed at that time to focal-head irradiation with X rays.

These experimental Ss had received 3,000 r X-ray radiation to an area of the brain containing the inferior parietal lobule and posterior aspect of the temporal lobe. Thirty days later they had received the same dosage to the same area of the brain.

2. Apparatus

The testing was conducted in a modified version of the Wisconsin General Test Apparatus (WGTA), the holding cage of which measured $36 \times 30 \times$

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¹ This work was conducted at The Radiobiological Laboratory of The University of Texas and the United States Air Force and supported (in part) by Contract AF 41(657)-382 and the School of Aerospace Medicine.

24 inches. The spatial separation between the two extreme food wells on the stimulus tray was 12 inches. Two wooden blocks which differed in multiple dimensions served as test objects.

3. Procedure

Each *S* was tested 24 trials per day for two days on response latency to a single food-rewarded wooden block placed randomly over either of the two extreme food-well positions and, then, 24 trials per day for two days on response latency to either the same food-rewarded wooden block or to a nonfood-rewarded wooden block presented simultaneously. When, on each trial, the *E* raised the forward opaque screen of the WGTA, a clock was activated. The clock stopped when the *S* pushed a wooden block from over the food well.

Response latency in milliminutes was recorded on each trial. The dependent variables utilized for statistical analyses were each *S*'s median response latency for each day of testing and each *S*'s shortest or optimal response latency for each day of testing. Each statistical treatment utilized a mixed-type analysis-of-variance design.

C. RESULTS

Figure 1 shows the mean median response latencies for the *Ss* of each group during successive days of testing. Statistical treatment of the data on which the first two points of Figure 1 are based yielded a difference between days which was beyond the .05 significance level. Neither of the remaining two *F* ratios was significant. Statistical treatment of the data on which the last three points of Figure 1 are based yielded a difference between days which was beyond the .025 significance level and no other significant *F* ratios. In other words, the groups improved in a similar fashion at comparable levels of efficiency on initial training and were disrupted in a similar fashion when the novel nonrewarded wooden block was introduced.

Figure 2 shows the mean optimal response latencies for the *Ss* of each group during successive days of testing. Statistical treatment of the data on which the first two points of Figure 2 are based yielded no significant *F* ratios. Treatment of the data on which the last three points of Figure 2 are based, however, yielded a groups-by-days effect which was beyond the .05 significance level. In this instance, the groups were comparable during initial training and showed no improvement with practice. Introduction of the novel nonrewarded wooden block disrupted the optimal response latencies of the focal-head irradiated *Ss*, but not those of the normal *Ss*.

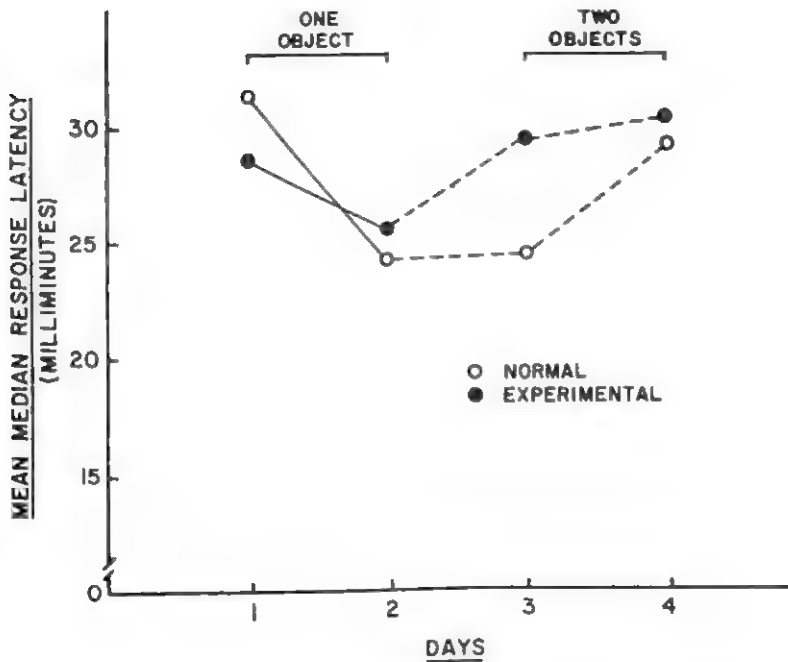


FIGURE 1
MEAN MEDIAN RESPONSE LATENCIES FOR THE Ss OF EACH GROUP DURING SUCCESSIVE DAYS OF TESTING

D. DISCUSSION

The findings of the present study are in accord with earlier work showing the disruption of median or usual response latencies of normal Ss when a novel nonrewarded stimulus object is introduced into an instrumental conditioning situation. The findings, also, show that Ss with previous focal-head irradiation of the posterior association areas, unlike relatively "high-dose" whole-body irradiated Ss, manifest median response latencies comparable to those of control Ss and show disruption of median response latencies comparable to that for control Ss when a novel nonrewarded stimulus block is introduced. In addition, the focal-head irradiated Ss showed disruption of optimal performance proficiency when the novel stimulus was introduced, while the control Ss maintained their former level of optimal performance proficiency.

Such data indicate, as has earlier research (2), the lasting effects of focal-head irradiation with X rays, and suggest again that the sites of permanent damage for monkeys given sublethal whole-body radiation exposure are other than those of the restricted areas of exposure of the Ss of the present

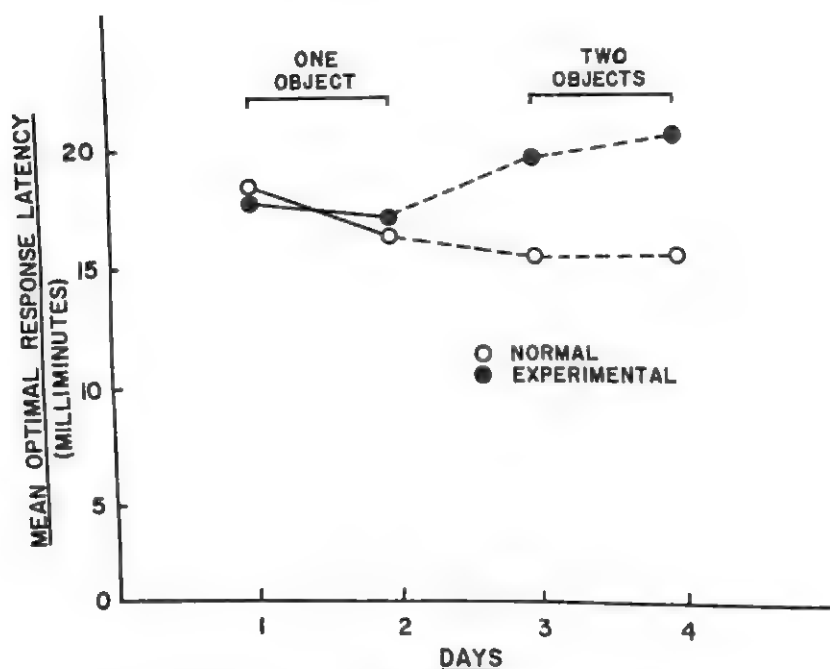


FIGURE 2
MEAN OPTIMAL RESPONSE LATENCIES FOR THE *Ss* OF EACH GROUP DURING SUCCESSIVE DAYS OF TESTING

study. In addition, the data, particularly with respect to optimal performance efficiency, suggest a variable of potential interest to those engaged in testing the behavioral effects of surgical assault of various parts of the brain of the rhesus monkey.

E. SUMMARY

Five normal monkeys and four monkeys with previous focal-head irradiation of the posterior association areas were tested in a modified version of the WGTA, 24 trials per day for two days, on response latency to a single food-rewarded wooden block placed randomly over either of the two extreme food-well positions and, then, 24 trials per day for two days on response latency to either the same food-rewarded wooden block or to a novel nonrewarded wooden block presented simultaneously. The following results were obtained.

1. On the single-block condition, median response latencies of the *Ss* of the two groups were comparable and the *Ss* of the two groups improved in a similar manner with practice. Optimal performance latencies were, also, comparable for the *Ss* of the two groups.

2. When the novel nonrewarded stimulus block was introduced, the Ss of both groups manifested comparable disruption of median response latencies. Disruption of optimal response latencies was shown only by the Ss of the focal-head irradiated group.

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SEX AS A FACTOR IN POSITION-POSTREMITY RESPONSES OF RHESUS MONKEYS*¹

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A. PURPOSE

Previous research has shown that female rhesus monkeys are superior in learning performance to male rhesus monkeys on identical-cue, spatial delayed-response problems and on discrimination problems with reduced stimulus cues (1, 2). The essential nature of both types of problem is such that the S is consistently rewarded if he responds to that spatial position last temporally contiguous with primary or secondary food reinforcement. Each type of problem, in other words, places a premium on position-postremity responses.

The present study was concerned with determining if female monkeys with previously demonstrated superiority to male monkeys both on identical-cue, spatial delayed-response problems and on discrimination problems with reduced stimulus cues (2), show a greater tendency to position-postremity responses than male monkeys when the requirements of the test situation place no special premium on such responses.

B. MATERIALS AND METHODS

1. Subjects

Thirty-three male and 23 female rhesus monkeys were employed as Ss. Fifty of the Ss had been exposed to nuclear radiations at the Nevada Test Site almost four years before the present study was initiated. Details of the radiation dosimetry have been presented previously (2) and are excluded here since the primary concern is with sex differences, although the radiation variable was included in the data analysis. The training histories of the Ss were identical and included a variety of Wisconsin General Test Apparatus (WGTA) discrimination problems.

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¹ This work was conducted at the Radiobiological Laboratory of the University of Texas and the United States Air Force and supported (in part) by Contract AF 41(657)-382 and the School of Aerospace Medicine.

2. *Apparatus*

All testing was conducted in a modified version of the WGTA, with the animal transport cage serving as the holding cage during the test procedure. A stimulus tray holding two food wells spaced 12 inches apart, center-to-center, was used. The stimulus objects were two black and one white wooden blocks, each measuring $3'' \times 3'' \times 3/4''$.

3. *Procedure*

The test procedure followed that previously used by Overall and Brown (3). Each *S* was given 42 training trials every day for four days on a black-white discrimination. Eight test trials, trials presenting two black (positive) stimuli, were interspersed among each day's training trials. Two of the test trials each day followed two successive rewarded responses to the right-side food well, two followed two successive rewarded responses to the left-side food well, two followed three successive rewarded responses to the right-side food well, and two followed three successive rewarded responses to the left-side food well. The order and position of occurrence of the test trials were differentially randomized for each day of testing. Each response during test trials which was to the same position as the immediately preceding training trial was recorded as a position-postremity response.

Errors on training trials preceding test trials on the initial day of testing precluded the inclusion of the first day's scores in the data treatment. All statistical analyses were, accordingly, based on frequency of occurrence of position-postremity responses during the last three days of testing.

C. RESULTS

Statistical analysis of the frequency data, using a nonorthogonal analysis of variance procedure, failed to yield significant results for the radiation variable, but gave a sex effect which was beyond the .005 significance level. The mean frequencies of position-postremity responses during the three days of testing were 14.75 for the female *Ss* and 12.33 for the male *Ss*.

Figure 1 shows the proportion of *Ss* of each sex manifesting a greater than chance frequency of position-postremity responses. Statistical comparison of the *Ss* of the two sexes with respect to this variable yielded a chi-square value of 9.4719 which, for one degree of freedom, is beyond the .01 significance level. A significantly larger proportion of female *Ss* than of male *Ss* showed a greater-than-chance frequency of occurrence of position-postremity responses. In addition, the proportion of female *Ss* with a greater than chance frequency

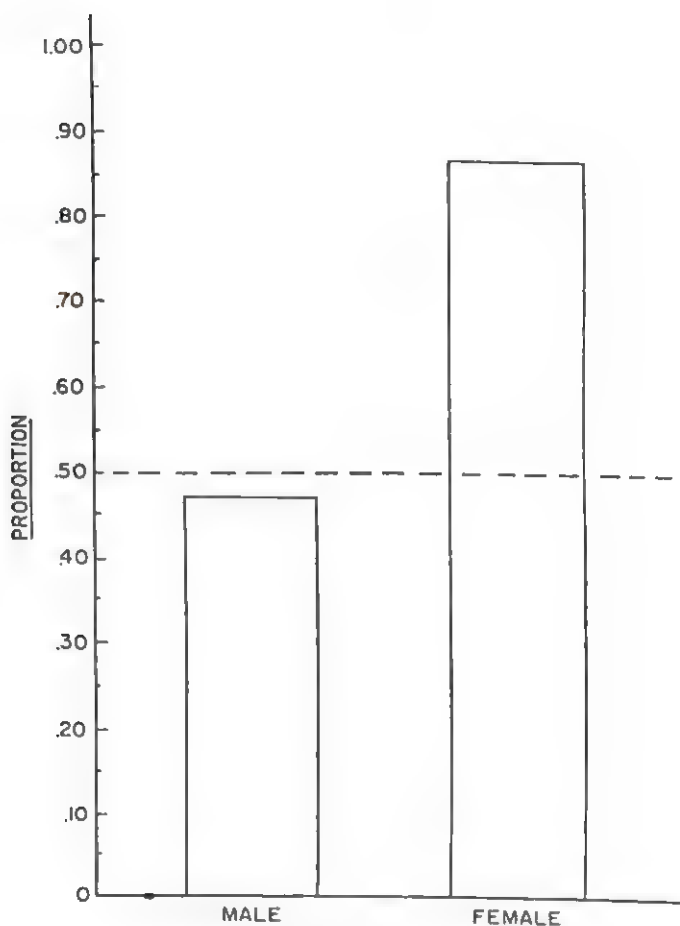


FIGURE 1
PROPORTION OF Ss OF EACH SEX WITH A GREATER-THAN-CHANCE FREQUENCY OF
POSITION-POSTREMITY RESPONSES

of position-postremity responses differed from chance beyond the .001 significance level.

D. DISCUSSION

The findings of the present study show that female monkeys manifest a significantly greater tendency to position-postremity responses than male monkeys in a test situation placing no special premium on such responses. These findings are in accord with test results on tasks which differentially reward position-postremity responses. Such findings give added support to the position that facilitated learning performance of female monkeys is due to greater

concentration of attention than that of male Ss rather than to greater capacity for learning.

E. SUMMARY

Thirty-three male and 23 female rhesus monkeys that had previously been exposed to varying dosages of nuclear radiations were compared with respect to position-postremity responses in a test situation placing no special premium on such responses. Each S was given 42 training trials every day for four days on a black-white discrimination. Eight test trials, trials presenting two black (positive) stimuli, were interspersed among each day's training trials. Each response during test trials which was to the same position as the immediately previous training trial was recorded as a position-postremity response. Analysis of the position-postremity data for the last three days of testing gave the following results:

1. The frequency of position-postremity responses was significantly greater for the female than for the male Ss.
2. The proportion of female Ss showing greater-than-chance frequency of position-postremity responses was significantly larger than the proportion of male Ss.
3. The proportion of female Ss showing greater-than-chance frequency of position-postremity responses was significantly larger than chance.

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SOME DIFFERENCES IN EXTINCTION BY NORMAL AND WHOLE-BODY IRRADIATED MONKEYS*¹

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A. PROBLEM

Facilitative effects of radiation exposure on performance of rhesus monkeys have been demonstrated on a number of tasks. Numbering among these are spatial delayed response (2, 7), discrimination problems with reduced stimulus cues (5), difficult planometric discriminations (8, 13), transfer along a peripheral cue gradient (4), peripheral cue discrimination learning (9), oddity concept (2), oddity reversal (5), and preliminary Wisconsin General Test Apparatus discrimination learning (10). Such tasks measure primarily acquisition, retention, or both.

The present investigation sought, in contrast, to explore effects of radiation exposure on extinction. The purpose of the initial study was to seek an extinction criterion which would differentiate irradiated and normal monkeys. The second study was conducted to validate, with an independent group of Ss, the criterion of extinction defined by the first.

B. MATERIALS AND METHODS

1. Initial Study

In the initial study, four normal and 16 whole-body irradiated male rhesus monkeys served as Ss. These Ss were the survivors of a comprehensive study of whole-body irradiation effects (1) conducted more than five years earlier. The estimated total dosages received from a mixed gamma and neutron radiation source by the animals of the various subgroups during the course of the initial study included zero, 77, 154, 308, and 616 rep. The numbers of survivors in each of these groups that served as Ss in the current study, listed in order of increasing radiation dosage, were four, three, four, six, and three. The training histories were nearly identical and included a vast array of Wisconsin General Test Apparatus (WGTA) tasks.

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¹ This work was conducted at The Radiobiological Laboratory of The University of Texas and the United States Air Force and supported (in part) by Contract AF 41(657)-382 and the School of Aerospace Medicine.

All testing of *Ss* in this study was conducted in a modified version of the WGTA, the holding cage of which measured 36 by 30 by 24 inches. A stimulus tray holding two food wells, spaced 12 inches apart, center-to-center, was used. The stimuli for testing were two wooden test objects differing in multiple dimensions.

Each *S* was tested for 24 trials on discrimination of the food-rewarded stimulus from the stimulus that was consistently nonrewarded. Then, the *S* was immediately tested for 24 trials with neither stimulus rewarded. Response latency was recorded on each trial, with the restriction that if any *S* refused to respond within one minute on a given trial that trial was terminated and the next was commenced. In order to procure measures of response latency, the WGTA was so modified that a clock was activated when *E* raised the forward opaque screen. The clock stopped when the *S* pushed a stimulus block from over a food well.

After collection of the data, the only comparisons attempted were between the control *Ss* as one group and all of the irradiated *Ss*, irrespective of the dosages, as the second group. First, the error and response-latency data of the last 10 trials of the learning period were inspected to determine the comparability of the *Ss* of the two groups with respect to final level of acquisition. Then, the latency data for the extinction period were examined in an attempt to find a latency criterion which would separate the *Ss* of the two groups both with respect to number of trials to the initial occurrence of the latency criterion and with respect to frequency of occurrence of trial latencies at or beyond the latency criterion. After trying and discarding latency criteria of 1000 milliminutes and 100 milliminutes, it was found that a latency criterion of 50 milliminutes would serve the intended purpose.

2. Validation Study

The *Ss* of the validation study numbered among the male and female survivors of an exposure to nuclear radiations which took place approximately three years earlier. In this, as in previous studies, the control *Ss* and the *Ss* exposed to estimated total radiation dosages of 273 and 299 rem constituted the "low-dose" group; *Ss* exposed to estimated total radiation dosages of 355, 397, and 439 rem constituted the "medium-dose" group; and *Ss* exposed to estimated total radiation dosages of 512, 608, and 670 rem constituted the "high-dose" group.

The procedures of testing for the *Ss* of this study were identical to those used in the initial study. Since, however, the level of sophistication of the *Ss* in this study was not as great as that of the *Ss* of the initial study, it was

deemed necessary to use only those *Ss* that manifested proficient learning. The criterion for rejection of a *S* from the study was three or more errors during the last 10 trials of learning. The number of *Ss* qualifying as "learners" and used for the test of the radiation-extinction prediction derived in the initial study were five females and nine males in the "low-dose" group, six females and seven males in the "medium-dose" group, and two females and 14 males in the "high-dose" group.

C. RESULTS

1. Initial Study

During the last 10 trials of the learning period of this study, the median errors for the *Ss* of the control and irradiated groups, respectively, were 1 and zero, the mean median response latencies were 17.1 and 20.2 milliminutes, and the median frequencies of response latencies as large or larger than 50 milliminutes were zero and zero. The *Ss* of the two groups failed to differ significantly with respect to each of these three variables.

During extinction, Figure 1 shows, on the left, the mean trials to the initial occurrence of a response latency of 50 milliminutes or larger for the *Ss* of the control and irradiated groups. Statistical analysis, using an analysis of variance procedure, yielded a difference between groups which was beyond the .01 significance level. The irradiated *Ss* achieved response latencies of 50 milliminutes or larger faster than did the control *Ss*.

Figure 1 also shows, on the right, the mean frequency during extinction of response latencies at or above 50 milliminutes for the *Ss* of each of the two groups. Statistical analysis, in this instance, yielded a difference between groups which was beyond the .025 significance level. The irradiated *Ss* had more response latencies at or above 50 milliminutes than did the control *Ss*.

2. Validation Study

During the last 10 trials of the learning period of this study, the means of the median errors for the *Ss* of each sex were for the *Ss* of the "low," "medium," and "high" dose groups, respectively, zero, .75, and 1.00, the means of the mean median response latencies were 24.4 milliminutes, 27.3 milliminutes, and 26.8 milliminutes, and the means of the median response latencies at or above the extinction criterion were .50, .25, and .75. The *Ss* of the three relative-radiation-dosage groups failed to differ significantly with respect to each of these three variables.

Figure 2 shows, on the left, the mean trials during extinction to the achievement of the extinction criterion for the *Ss* of each of the three

relative-radiation-dosage groups. Statistical analysis, using a nonorthogonal analysis of variance procedure, yielded a difference between groups which was beyond the .05 significance level for a one-tailed test of the theoretical hypothesis of facilitation of extinction by exposure to radiation. The *Ss* of the two higher relative-radiation-dosage groups achieved the extinction criterion in a comparable time and sooner than the *Ss* of the "low-dose" group.

Figure 2 also shows, on the right, the mean frequency during extinction of

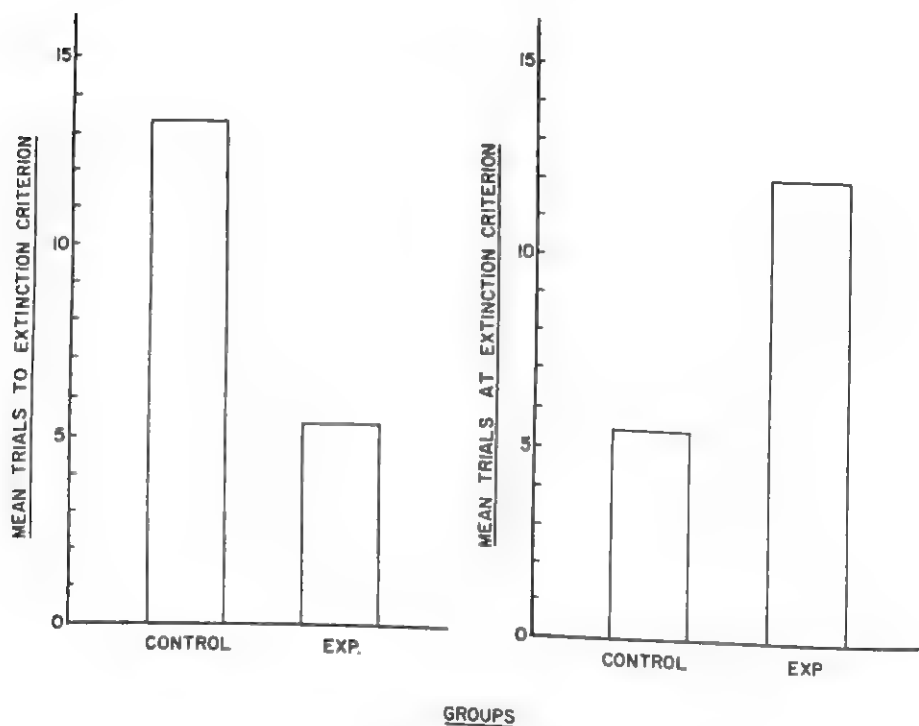


FIGURE 1

MEAN TRIALS TO EXTINCTION CRITERION (LEFT) AND MEAN TRIALS AT EXTINCTION CRITERION (RIGHT) FOR THE *Ss* OF THE CONTROL AND IRRADIATED GROUPS

response latencies which were at or beyond the extinction criterion for the *Ss* of each of the three relative-radiation-dosage groups. Statistical analysis, in this instance, yielded a difference between groups which was beyond the .025 significance level for a one-tailed test of the theoretical hypothesis. The *Ss* of the two higher relative-radiation-dosage groups had a comparable number of response latencies at or beyond the extinction criterion and more than the *Ss* of the "low-dose" group.

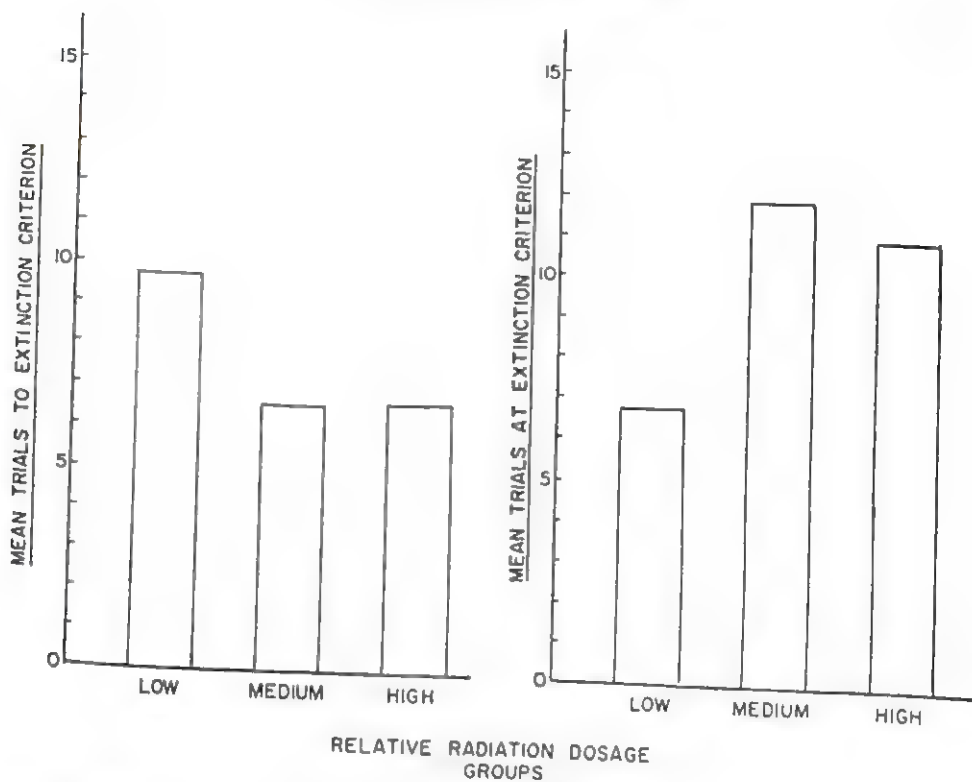


FIGURE 2
MEAN TRIALS TO EXTINCTION CRITERION (LEFT) AND MEAN TRIALS AT EXTINCTION CRITERION (RIGHT) FOR THE Ss OF THE THREE RELATIVE-RADIATION-DOSAGE GROUPS

D. DISCUSSION

The data of the present study are in direct support of an hypothesis of facilitation of extinction by exposure to radiation. It is the interpretation of the authors that such findings reflect, in all probability, but another facet of the increased concentration of attention of irradiated Ss (3, 11, 12), a concentration of attention, which, in the present instance, facilitates the perception of any change associated with the site of food reward. Interpretations aside, the findings are consistent with the earlier-cited results of a number of studies which have shown facilitation of acquisition and retention accruing to radiation exposure, and extend the realm of facilitative effects of radiation exposure to include extinction.

E. SUMMARY

The initial study of this investigation sought and found an extinction criterion which significantly separated normal and whole-body laboratory-

irradiated monkeys in favor of facilitated extinction for the irradiated Ss. The efficacy of this extinction criterion was validated in a second study in which "high" and "medium" dose field-irradiated Ss showed facilitated extinction over "low-dose" field-irradiated Ss.

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SEX DIFFERENCES IN ACHIEVEMENT MOTIVE IN MATHEMATICS AS RELATED TO CULTURAL CHANGE*¹

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A. INTRODUCTION

McClelland (2, pp. 78-79), in his theory of motivation, postulates that the development of the achievement motive in most cases requires the structuring of performance standards for the child. These demands are communicated to him by his parents and others who have been influenced by the surrounding culture. The child learns to perceive his performance in terms of what is expected of him. These expectations will vary from one culture to another and from time to time within the same culture.

In a series of controlled experiments, McClelland and co-workers were able to demonstrate that the achievement motive can be experimentally produced. Little work, however, has been done demonstrating the effect of cultural change on motivation in a real life situation. In our own society, since the launching of the first Russian Sputnik, a significant attempt has been made to motivate student interest in science and mathematics. This paper will review briefly the findings of McClelland *et al.* in regard to sex differences and compare them with a study of attitude toward mathematics of all incoming freshmen students at the University of California at Davis in September, 1955, and again in September, 1960.

In a series of studies following a pattern originally set up by McClelland, Veroff found that a sex difference existed as a result of achievement-orienting experiences (2, Ch. VI). Imaginative stories in response to modified TAT cards were used to measure the degree to which the achievement motive had been aroused. The cards were presented under two experimental conditions. The first was regarded as "neutral" where, preceding the administration of the TAT cards, the high-school students were told that the tester was interested in seeing what kinds of stories people write. In the second situation

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an attempt was made to arouse the achievement-oriented condition by pointing out to the students that the test was used for the selection of men and women for future leadership roles and other important duties. Further, that the test had been given to college students and that the investigators were now interested in how well high-school students would perform. Also, that students from M_____ (a rival high school) had previously done very well. Achievement scores were derived by an analysis of each story in terms of achievement theme. Veroff found that the girls were higher than the boys in "mean achievement scores" both in the neutral and achievement-oriented situations, but the boys scored significantly higher as a group in the latter situation, while there was no such change in the girls. Studies by Wilcox and Field (2, pp. 173-182) confirm the findings of Veroff, i.e., men but not women show an increase in scores as a result of achievement-involving instructions when they refer to leadership and intelligence. Field also found that although women did not respond when references were made to leadership and intelligence, they did respond where the achievement involved social acceptability.

B. OBJECTIVES AND METHODOLOGY

During the five-year period between our assessment of attitudes and achievement in mathematics, an effort on the part of the culture was made to point to the importance of science and mathematics for national survival. The schools were criticized in numerous periodicals and newspaper articles for offering too few "solid" subjects, and students were blamed for avoiding those that were taught. As a result of personal interest in the experiences and attitudes of the students, a survey was made of attitudes toward mathematics of all incoming freshmen (208 males and 188 females) in the fall of 1955 on the Davis campus of the University of California. Five years later, in the fall of 1960, in order to assess any possible changes, the same survey instrument was readministered to all incoming freshmen (309 males and 460 females). It was assumed in the comparison of the 1955 and 1960 samples that the major variable was the intervening national propaganda, which became highly emphatic during the latter part of this period with the advent of the Russian Sputnik.²

² A problem of major importance is whether or not there was a significant difference in the sample in 1955 and 1960. There is no way one can be sure that the samples were comparable, although it is believed they were of sufficient similarity to make valid comparisons. The entrance requirements of the University make it necessary to draw upon (approximately) the top 12 per cent of high-school graduates in the state. No change in entrance requirements had been made in the intervening period. Unfortunately between 1955 and 1960 the tests at entrance had been changed. The comparisons which were possible indicated no significant differences in IQ levels

The present paper deals with the effects of propaganda cues directed toward students to influence scholarship and attitude toward mathematics. It examines data collected to test the hypothesis that the cultural emphasis upon the importance of mathematics education between 1955 and 1960 acted upon high-school students as strong cues to affect their interest and achievement motivation. It is believed that the present situation was not unlike the experimental one set up in the McClelland motivation research. Our 1955 survey was, in effect, administered under "neutral" conditions in that the students as a group had not been as impressed with cultural concern regarding achievement in mathematics. The 1960 group, however, was regarded as having been achievement-oriented since they had been influenced by repeated cues to excel during this period. One such cue, an A.P. press release in 1955 by General Lewis Hershey, National Director of Selective Service, pointed out his concern about the "softness" of American youth. Among other things, he said, "We have not yet proved our youth can take easy courses to get some degree in college and still remain tough in mind, nor that we can enjoy all of our entertainment and privileges and still be tough and able to accept our responsibilities." He specifically pointed to the shortage of engineers which he said was brought on by the "inability of kids to study mathematics." He added that "we hear nothing about Russia's having a shortage of engineers," and he blamed the home for failing to instill in youth a sense of obligation to the country.

Organizations such as the American Association for the Advancement of Science began an intensive campaign to stimulate interest in science and mathematics (1) as did many other organizations and individuals with national reputations. Charles Allen Thomas, president of Monsanto Chemical and recipient of the 1955 Priestley Medal by his colleagues of the American Chemical Association, said in the medal-presentation ceremony that sample surveys show that teenagers voted mathematics as the most unpopular subject in school. He called for programs to educate youth in the importance and necessity of scientific careers and added that science and industry as well as "all men of science should talk and listen to the young" (4).

This theme was picked up and emphasized repeatedly during the period that our 1960 sample attended high school.

of the two groups. The increase in enrollment for both males and females was in the College of Letters and Science whereas in 1955 a greater percentage of students were in Agriculture. Since Agriculture on the Davis campus is strongly science-oriented, it might be expected that, if anything, the change would be toward greater interest in subjects *other* than math. However, there were no significant differences found between students enrolled in the two colleges.

Reference of various cultural propaganda cues regarding intelligence, leadership, occupational success and competition with the other "team" (Russia) was intended particularly to influence students to pursue courses of study leading to high achievement in fields based upon the study of science and mathematics. The repetition of cultural cues, which seemed remarkably similar to those used in the study by Veroff, led the investigators to hypothesize that the males but not the females of our "achievement-oriented sample" (1960 freshmen) would show significantly greater evidence of motivation to achieve in mathematics than did the "neutral" (1955 freshmen) sample.

C. RESULTS

1. Overall High-School Grade Averages

As in McClelland's findings, the girls indicated records of greater achievement than did the boys. In the 1955 sample, 35.4 per cent of the boys and 58.9 per cent of the girls reported having "B plus" or higher grade averages in high school. In the 1960 sample, 57.4 per cent of the boys and 72.5 per cent of the girls reported "B plus" or higher overall high-school grade averages.

TABLE 1
STUDENTS' RATING OF OVERALL SCHOLARSHIP AVERAGE IN HIGH SCHOOL.

Grade	Per cent college freshmen in 1955		Per cent college freshmen in 1960	
	M	F	M	F
A	6.4	15.1	10.5	20.7
B+	29.0	43.8	46.9	51.8
B or less	44.6	35.7	38.7	26.4
C	20.0	5.4	3.9	1.1
Total number	204	175	293	459
No answer (number)	4	13	16	1

Note: 1955 MF $\chi^2 = 29.35$, $p < .01$.
 1960 MF $\chi^2 = 28.03$, $p < .01$.
 1955-60 M $\chi^2 = 44.14$, $p < .01$.
 1955-60 F $\chi^2 = 18.38$, $p < .01$.

The differences in both cases were significant at the .01 level by the chi-square test. Both the boys and the girls in the 1960 sample reported significantly higher grades than did the same sex sample in 1955. It can be noted, however, from Table 1, that while the increase in the percentage of boys who had "B plus" or higher grade averages in the 1960 sample was 22 per cent, an increase of 13.6 per cent was found for the girls. Overall high-school scholastic

achievement, then, as rated by the students, increased significantly for both sexes from 1955 to 1960, but showed a greater increase for boys than for girls.

2. High-School Grades in Mathematics

Since most students had completed first-year high-school algebra, the reported grades in this course were used as a rough estimate of their high-school mathematics achievement. Again, while the grades of both sexes were significantly higher in 1960 than in 1955, the boys' grades showed the greater change (Table 2).

TABLE 2
REPORTED AVERAGE FIRST-YEAR ALGEBRA GRADE IN HIGH SCHOOL

Grade	Per cent college freshmen in 1955		Per cent college freshmen in 1960	
	M	F	M	F
A	28.2	33.7	46.0	43.2
B	44.6	45.5	37.8	42.2
C or less	27.2	20.8	16.2	14.6
Total number	184	187	304	460
No answer (number)	24	1	5	0

Note: 1955 MF $\chi^2 = 2.5$, $p < .30$.
 1960 MF $\chi^2 = 1.5$, $p < .50$.
 1955-60 M $\chi^2 = 17.6$, $p < .01$.
 1955-60 F $\chi^2 = 6.3$, $p < .05$.

In both the 1955 and the 1960 sample no significant difference was found between the boys' and girls' algebra grades, although in 1955 the girls did somewhat better than the boys, while in 1960 the boys did somewhat better than the girls. While better performance was shown for both sexes in 1960 than in 1955, the difference was significant at well below the .01 per cent level for the boys, but only at the .05 per cent level for the girls. This is particularly significant when it is noted that 24³ out of 184 of the boys in the 1955 sample did not answer the question indicating that they did not take algebra in high school. Since this may be regarded as avoidance behavior, these students more than likely would have fallen into the lower grade bracket, making the difference between the 1955 and 1960 males greater than reported.

As with McClelland's study, the question can be asked whether or not the boys made greater improvement than the girls because they had more range to show improvement. Additional data indicate that the greater achievement of the boys was due largely to greater motivation.

³ Not included in the chi-square test.

Table 3 illustrates that while the girls' samples of 1955 and 1960 were remarkably similar in their rating of high-school grades in mathematics as compared with other subjects studied, the boys showed a significant grade increase at the .01 level. In 1955, although the boys rated themselves as having done somewhat better in math than in other subjects as compared with the

TABLE 3
STUDENT RATING OF HIGH-SCHOOL GRADES IN MATHEMATICS COMPARED WITH GRADES IN OTHER SUBJECTS

	Per cent college freshmen in 1955		Per cent college freshmen in 1960	
	M	F	M	F
Better	26.0	16.1	36.9	16.2
Same	46.6	48.9	43.7	48.0
Poorer	27.4	35.0	19.4	35.8
Total number	204	186	309	458
No answer (number)	4	2	0	2

Note: 1955 MF $\chi^2 = 6.54, p < .05$.
 1960 MF $\chi^2 = 49.36, p < .01$.
 1955-60 M $\chi^2 = 8.24, p < .01$.
 1955-60 F $\chi^2 = .05, p < .98$.

girls, it was significant at only the .05 level. In the 1960 sample, the difference between the 36.9 per cent of the boys who reported doing better in math than in other subjects and the 16.2 per cent for the girls is highly significant.

3. Student Ratings of Their Attitudes Toward Mathematics

The students were asked to scale their attitude toward mathematics (Table 4) and also to rate their attitude toward mathematics as compared with other subjects they had studied in high school (Table 5). Table 4 shows again the nearly identical responses of the girls' samples in 1955 and 1960, while a significant difference is found in the responses of the boys in the two samples. While in 1955, 25.4 per cent of the boys said they liked the subject very much, in 1960 37.9 per cent said they liked the subject very much. Similarly, Table 5 shows virtually no change in the responses of the girls of 1955 and 1960 while, again, the boys show a significant change. Of the male freshmen in 1955, less than a third (31.7) said they liked math better than other subjects, while in 1960 nearly half (46.9) of the sample claimed to like it better.

While the boys in the 1955 sample were significantly more favorable in their rating of their attitude toward math than were the girls, and a greater number of the boys stated they liked it better than other subjects, it did not seem to affect their reported achievement in high school since their average

TABLE 4
STUDENTS' RATING OF THEIR ATTITUDE TOWARD MATHEMATICS

Attitude	Per cent college freshmen in 1955		Per cent college freshmen in 1960	
	M	F	M	F
Like very much	25.4	26.1	37.9	27.8
Like some	42.9	30.3	41.7	34.4
Neither like nor dislike	14.6	12.8	8.8	10.8
Dislike	17.1	30.8	11.6	27.0
Total number	205	188	309	460
No answer (number)	3	0	0	0

Note: 1955 MF $\chi^2 = 12.71, p < .01$.
 1960 MF $\chi^2 = 30.27, p < .01$.
 1955-60 M $\chi^2 = 12.35, p < .01$.
 1955-60 F $\chi^2 = 1.98, p < .74$.

TABLE 5
STUDENTS' RATING OF THEIR ATTITUDE TOWARD MATHEMATICS AS COMPARED WITH OTHER SUBJECTS THEY HAD IN HIGH SCHOOL

Attitude	Per cent college freshmen in 1955		Per cent college freshmen in 1960	
	M	F	M	F
Better	31.7	24.2	46.9	24.8
Same	30.7	24.2	25.9	23.5
Less	37.6	51.6	27.2	51.7
Total number	195	186	309	460
No answer (number)	13	2	0	0

Note: 1955 MF $\chi^2 = 7.67, p < .05$.
 1960 MF $\chi^2 = 53.55, p < .01$.
 1955-60 M $\chi^2 = 12.32, p < .01$.
 1955-60 F $\chi^2 = 0.05, p < .97$.

first-year algebra grade (our criteria for high-school math achievement) was not significantly higher than the girls. In the 1960 sample, however, the increased stated interest in math on the part of the boys seemed to be related to higher achievement.

4. The Source of Achievement Motivation

In a report on the 1955 sample the authors concluded that "... the present lack of interest in mathematics is largely a cultural phenomena pervading not only the educational system of the country but also the family as an institution that conditions the attitudes of children" (3). Although a detailed analysis will not be made of parental influence, the expression of the students regarding their feelings of their parents' expectations will be presented.

In the 1955 sample, parental expectations of high-school math performance

was one of the factors most significantly related to attitudes toward mathematics. Since the culture can be most effective in communicating new attitudes to youth through primary groups and since we have evidence of attitude change, we can hypothesize some change in perceived expectations of parents regarding the achievement of their children in mathematics. Second, since we also have evidence that there were greater changes in the boys than in the girls, we can interpret that parental expectations will have been perceived as having been greater by the boys than by the girls. Tables 6 and 7 support

TABLE 6
STUDENTS' RATING OF FATHERS' EXPECTATION OF HIGH-SCHOOL GRADES IN MATHEMATICS

Grade	Per cent college freshmen in 1955		Per cent college freshmen in 1960	
	M	F	M	F
A	8.5	8.9	22.8	18.4
B	60.8	58.1	66.0	57.2
C or less	30.7	33.0	11.2	24.4
Total number	199	179	303	445
No answer (number)	9	9	6	15

Note: 1955 MF $\chi^2 = 0.23, p < .50$.
 1960 MF $\chi^2 = 20.90, p < .01$.
 1955-60 M $\chi^2 = 38.58, p < .01$.
 1955-60 F $\chi^2 = 9.77, p < .01$.

TABLE 7
STUDENTS' RATING OF MOTHERS' EXPECTATION OF HIGH-SCHOOL GRADES IN MATHEMATICS

Grade	Per cent college freshmen in 1955		Per cent college freshmen in 1960	
	M	F	M	F
A	8.7	6.9	26.7	14.9
B	60.9	58.5	57.3	55.2
C or less	30.4	34.6	16.0	29.9
Total number	207	188	307	453
No answer (number)	1	0	2	7

Note: 1955 MF $\chi^2 = 0.88, p < .50$.
 1960 MF $\chi^2 = 28.81, p < .01$.
 1955-60 M $\chi^2 = 32.83, p < .01$.
 1955-60 F $\chi^2 = 7.08, p < .05$.

these suppositions. Both the boys and the girls showed an increase in grade expectations; however, while the boys and girls did not differ significantly in their rating in the 1955 sample, a significantly greater number of boys in the 1960 sample reported higher grade expectations on the part of both parents.

D. DISCUSSION AND CONCLUSION

Results of controlled studies in achievement motivation by McClelland *et al.* have demonstrated that high-school and college males increased their achievement scores when presented with cues such as leadership and intelligence, while girls made no such increase. During the five-year period between 1955 and 1960 the society, in more-or-less organized fashion, expressed concern regarding the effects of the educational system of the country on its youth. A major segment of the concern was the lack of interest on the part of students in "solid subjects"—particularly mathematics. A survey of all incoming freshmen on the Davis campus of the University of California in the fall of 1955, and a similar sample in 1960, offered some opportunity to examine the effects of the motivation, i.e., cues presented to high-school students over the five-year period. As near as could be determined there was no significant difference in the ability level of the 1955 sample and the 1960 sample. The results were as follows:

1. Both girls and boys reported significantly better overall grades in high school in the 1960 sample than did those in the 1955 sample, but the boys reported the greater increase. In both samples, however, girls reported higher grades than did boys.
2. Reported grades in first-year algebra were used as the criterion of mathematics achievement in high school. Although both sexes reported significantly higher grades in the 1960 sample, the boys' grades showed a greater increase than did the girls'.
3. The girls in the 1960 sample did not differ from the 1955 sample in their expression of attitude toward mathematics, while a significantly greater number of boys in the 1960 sample said they liked math as a subject and also reported that they liked it "better" than other subjects they had studied in high school.
4. Both boys and girls in the 1960 sample viewed their parents as expecting higher grades in high-school mathematics than did those in the 1955 sample; however, in 1960 the boys reported their parents as expecting significantly higher grades than did the girls while there was no difference between the rating of the two sexes in the 1955 sample.

The findings of this study confirm the experimental results of McClelland *et al.* The motivational cues between 1955 and 1960 presented by the society and communicated to students by the teachers and parents stressed the need for greater achievement in "academic subjects," particularly mathematics. These cues were associated with occupational success, national pride, and

competition with Russia, and thus implied both individual and national leadership as well as intelligence. The evidence from this study indicates that girls responded to the more general plea for greater excellence in scholarship, but gives little indication that they responded to the specific request for greater interest and higher grades in mathematics. The increase in higher math grades shown for the girls between the 1955 and 1960 samples appeared to be related to a general increase in scholarship. The boys gave more evidence than did the girls of greater interest and achievement in the specific area of mathematics as the result of cultural cues designed to stimulate such motivation.

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MATERNAL INFLUENCES ON ANAL OR COMPULSIVE CHARACTER IN CHILDREN*

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A. INTRODUCTION

The history of the concept of anal or compulsive character has been previously traced (7). The concept owes its definition principally to Freud (8), though Weber (16) somewhat earlier described a rather similar syndrome which he called "the Protestant ethic and the spirit of capitalism." The three chief characteristics classically described by Freud are orderliness (including being neat, being clean, and being systematic), parsimony (being stingy or thrifty), and stubbornness. "Rigid," "compulsive," "conforming," and "authoritarian" are other words that have been applied. Noyes's textbook of psychiatry (13) sums up current concepts of the anal or compulsive personality, listing, besides Freud's three classical signs, the following:

Individuals of an obsessive or compulsive personality are ones whose super-ego functions are severe. They tend to be punctilious, rigid, fastidious, formal, meticulous, may be in constant doubt what to do and have to go over things again and again. They are overinhibited, perfectionistic, self-doubting, and are unable to carry on their work if under pressure. They lack a normal capacity for relaxation. They have an exaggerated sense of duty, are harrassed by their responsibilities and scrupulosities, and cannot make decisions. If circumstances require a decision regret is expressed for the choice which was made. The person of compulsive character is stubborn in his convictions and manifests a tendency to hair-splitting.

Freud thought his three primary characteristics were highly correlated, and he ascribed them to a common origin, namely, libidinal fixation at the anal stage. This theory has rarely been tested.

Sears (14) studied the intercorrelations of the three classical anal characteristics, in students rated by their fraternity brothers, and found significantly positive relationships. These relationships were found only when "halo effect" was partialled out, because students considered orderliness desirable, and the other two "anal" characteristics undesirable.

One difficulty in correlational studies is that the anal characteristics are said to be especially subject to reaction formation, so that either extreme

* Received in the Editorial Office on December 18, 1961. Copyright, 1963, by The Journal Press.

orderliness, for example, or its opposite, extreme disorderliness, may be considered as a sign of anal fixation. Such a situation would prevent relationships from being shown by the usual correlation methods. Accordingly, the present study was designed to measure anal personality, such that either extreme in certain characteristics (such as orderliness-disorderliness) would be counted toward anal fixation, and a medium rating would be scored as not anally fixated.

A causal chain of six links may be outlined for anal character, in psychoanalytic theory (Figure 1).

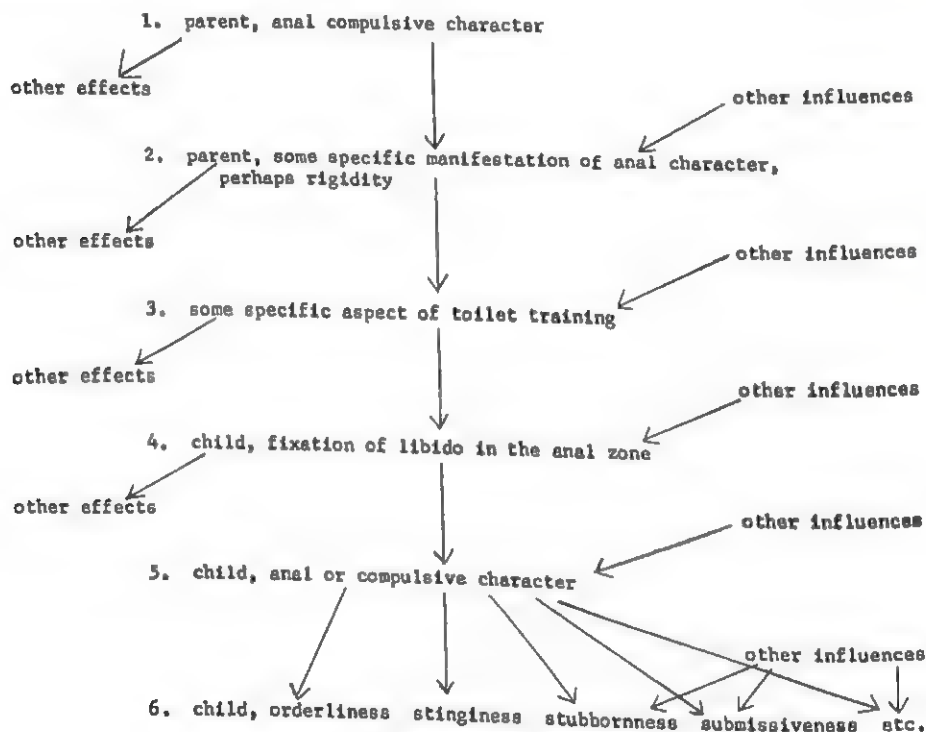


FIGURE 1
CAUSAL CHAIN HYPOTHESIZED FOR ANAL CHARACTER

It is presumed that the relationship is attenuated in passing from one link to another, since at each link the relationship is less than perfect, and other external influences come to bear. The expected result, then, is that whatever the maternal antecedent of anal character be, it should show a higher relationship to a measure of "anal character" in the child, than to a measure of orderliness, or stinginess, or stubbornness in the child. If this is so, the concept of

anal character is a useful and "valid" one; while if it is not so, the concept of anal character fails to be validated in relation to its antecedent causes.

Freud thought that such was the case in relation to the underlying cause, libidinal fixation at the anal stage. This hypothesis would be difficult to test because no way has been devised to measure libidinal fixation independently from its characterological effects. In the present study it was decided instead to test the relations of anal character and some of its components to the factor which is said to produce libidinal fixation, namely, maternal attitude, a link at what we have called *level 2*.

Fenichel (6, p. 305) states that anal fixation may be produced by toilet training which is too early, too late, too strict, or too libidinous. These are all concepts at what we have called *level 3*. The present study, intended to measure the parents at level 2, may also be considered as measuring the "too strict" dimension at level 3. Mothers were studied for rigidity of personality, itself an anal character trait, and one which might be manifest in strict toilet-training method.

An alternative theory has been suggested by Sears (15). Sears suggested that links 4 and 5 (including anal character) are unnecessary. He found that several aspects of child training (at the level of link 3) were highly related; that the mothers who were strict and rigid in toilet training were also strict and rigid in other dealings with the child, and made great demands for orderliness. He suggested that some of the so-called "anal" characteristics could be explained by direct training of orderliness; and that the relationship with toilet training and anal function might be coincidental.

Sears did not mention that the positive relationship among the several training practices may be itself a manifestation of an overall "anal character" on the part of the parent. The links at the levels 1 and 2 were not of concern to him.

The question, then, is whether parental variables are best related to fairly specific behavior patterns in the child (such as orderliness or stinginess), or are most fruitfully related through links at what we have called *level 4* (fixation of the child's libido in the anal zone) and *level 5* (overall anal character in the child). To that question the present study addresses itself.

The following anal characteristics in the child were selected for study: (a) general anal character, (b) stubbornness, and (c) submissiveness. The first is level 5, and the latter two are at level 6. The latter two components were selected because they are supposedly opposite ways of reacting to authority, and yet either of them, if they are extreme, or both of them, if they occur together, may be signs of anal character.

The following hypotheses were proposed:

1. Rigid mothers have children who are more stubborn than the average.
2. Rigid mothers have children who are more submissive than the average.
3. Rigid mothers have children who are more anal in character than the average.

These three hypotheses deal with the parent-child relationships. The fourth hypothesis concerns the validity of the concept of anal character:

4. Maternal rigidity shows a higher statistical relationship with the child's "anal character" than it does with either of the separate components, stubbornness and submissiveness. If hypothesis 4 is confirmed, the validity and usefulness of the concept of anal character is supported; and if not, not.

B. METHOD

Ratings of the 31 mothers on rigidity were made by a method that has been described in detail in the previous monograph (7).

The rating on the children calls for more comment. Ratings consisted chiefly of items answered by clinicians on a seven-point scale. Some items answered by teachers of the children were also included. The previous study did not include anal characteristics in the children, but the questionnaires that were used with the clinicians were designed to give a variety of information about a child's personality and character, and a review of the items showed that a number of them were relevant to anal character. A selection was made by judging the conformity of each item's content with the concepts of stubbornness, submissiveness, and anal character that were intended. On that basis, some items, those that seemed most directly relevant, were weighted two or three times and others only as one; and on some items only the deviations in one direction from the mean were counted. For the total rating of anal character, a special procedure was used for scoring certain items; for these items, both positive and negative deviations from the mean were scored positively (i.e., as anal), so that only a rating near the mean will count as absence of anal character.

The items scored on the stubbornness scale were as follows:

3. He tends to be rebellious and nonconforming.
5. Sometimes he can be stubborn. (Weighted times 3.)
30. He insists on being in control of situations.
55. He rebels against being told what to do. He sometimes does things just to show people they can't tell him what to do.
- PE12. How much does this person resist (or object to) being told what to do? (Weighted times 2.)

- 2. He's usually compliant and obedient; does what he's told. (Scored negatively.)
- 78. He's a rather submissive person. (Scored negatively.)
- 84. He prefers someone else to make the decisions, and he goes along with what the other one wants. (Scored negatively.)
- W2. Teachers' item W2: "stubborn."

The items scored on the submissiveness scale were as follows:

- 2. He's usually compliant and obedient; does what he's told. (Only positive deviations.)
- 22. He likes to play in a messy way, disorderly, or perhaps smearing. (Only negative deviations, scored as positive.)
- 52. Often he is very neat and orderly, careful to put things back where they belong, or to clean up. (Only positive deviations.)
- 78. He's a rather submissive person. (Only positive deviations, weighted times 3.)
- 84. He prefers someone else to make the decisions, and he goes along with what the other one wants. (Only positive deviations, weighted times 2.)
- PE11. How much does this person seem to like being told what to do? (He acts in such a way that other people try to urge him, persuade him, or tell him what to do.) (Weighted times 2.)

The items scored on the scale for anal character were as follows:

- 2. He's usually compliant and obedient; does what he's told. (Both positive and negative deviations from the mean counted as positive.)
- 3. He tends to be rebellious and nonconforming. (Both positive and negative deviations from the mean counted as positive.)
- 5. Sometimes he can be stubborn. (Positive deviations from the mean weighted times 3; negative deviations also counted positively but weighted only once.)
- 22. He likes to play in a messy way, disorderly, or perhaps smearing. (Both positive and negative deviations scored as positive.)
- 30. He insists on being in control of situations. (Positive deviations from the mean weighted times 2; negative deviations also counted positively but weighted only once.)
- 52. Often he is very neat and orderly, careful to put things back where they belong, or to clean up. (Scored same as item 30.)
- 55. He rebels against being told what to do. He sometimes does things just to show people they can't tell him what to do. (Only positive deviations from the mean are scored, and weighted times 2.)
- 59. He's very careful to obey the rules; becomes anxious if he's violated them. (Weighted times 2.)
- 68. He tends to accumulate things and hold on to them, more than he can immediately use.
- 78. He's a rather submissive person. (Scored as item 5.)

84. He prefers someone else to make the decisions, and he goes along with what the other one wants. (Scored as item 30.)

119f. When things go wrong, when he's in frustrating circumstances and is prevented from getting what he wants, he persists in trying, by his own efforts. (Only positive deviations from the mean scored.)

PE12. How much does this person resist (or object to) being told what to do? (Weighted times 2.)

PE11. How much does this person seem to like being told what to do? (He acts in such a way that other people try to urge him, persuade him, or tell him what to do.) (Weighted times 2.)

PE10. How important is it to this person to be orderly, meticulous, organized or systematic? (Weighted times 2.)

PE22. How much does it bother this person when other people don't do things the way he feels they ought to, in matters where he is not directly concerned? (Use extreme score for a sadistically controlling person.) (Weighted times 2.)

PE39. To what extent does this person's character consist of reaction formations against unacceptable impulses (such as conscientious self-restraint as a reaction against aggressiveness, or conscientious kindness as a reaction against cruel impulses, or conscientious generosity as a reaction against selfishness)? (Weighted times 2.)

W2. Teachers' item W2: "stubborn." (Weighted times 3.)

W6. Teachers' item W6: "evasive."

The total score on each scale for each child was obtained by adding the scores on all the items in the scale. In cases where two clinicians had seen the child, both rated him, and the scores were averaged.

These rather crude and somewhat arbitrary methods of selecting items and weighting them were used, for lack of anything better, to get a roughly quantitative measure of anal character traits in the children.

The correlations between the anal characteristics and the other personality characteristics that had been measured on the same children were also computed.

C. RESULTS

1. *Relationships Within the Child*

The relations of the various measures within the child are shown in Table 1. Ratings of the children on stubbornness and submissiveness were negatively correlated ($-.60$). But both were correlated positively ($+.25$ and $+.44$ respectively) with anal character. This result is somewhat to be expected if stubbornness and submissiveness are alternative manifestations of the more fundamental variable, anal character; and the result was partly determined by the method of scoring. The strong negative correlation between stub-

bornness and submissiveness was not intended, and may be a sign that the ratings on stubbornness were too much contaminated with rebelliousness and aggression.

Several other anal variables were scored also, but their validity and reliability are doubtful because only two or three items were used. Thus, scores on rebelliousness, orderliness, rigidity, stinginess, obsession, and reaction formation were obtained for what clues they might offer, but are not regarded as reliable.

That stubbornness, as measured in the study, was related to self-confident aggression, is shown by its negative correlations with measures of dependency, anxiety, embarrassment, repression, conscience development, orderliness, reaction formation, and phobia; and by its positive relationships with overt aggression, total hostility and aggression, rigidity, rebelliousness, and demandingness. Its highest positive relationships were with rebellion (+.75) and overt aggression (+.76). It was unrelated to passive or covert hostility (+.12).

The rating of submissiveness showed some interesting relationships with characteristics outside the anal group. It was somewhat negatively related (— .39) to the total hostility rating; i.e., submissive children tended to be rated nonhostile. Further analysis showed, however, that it was the relationship with overt aggression (— .56) that accounted for that result; the relationship with passive hostility was positive (+.37); i.e., submissive children tended to be rated as passively resentful or sullen, or with feelings easily hurt. There was a positive relationship (+.53) with conscience ratings; i.e., submissive children tended to be rated high in conscience development. A positive relationship also appeared with repression (+.37). All four of the "oral" qualities which were so highly correlated with each other were also correlated with submissiveness; correlations were +.47 for dependency, +.29 for pessimism, +.56 for anxiety, and (as mentioned) +.37 for passive or covert hostility. There were also positive correlations with reaction formation, orderliness, obsession, guilt feeling, embarrassment, psychotic trend, and achievement urge; and negative correlations with rebelliousness, demandingness, and exhibitionism (Table 1).

The total anal character measurement showed fewer significant correlations with other variables. Its most interesting ones were +.48 with passive hostility and +.37 with conscience development. Its other positive relationships were with guilt, achievement need, orderliness, rigidity, obsession, reaction formation, and (of borderline significance) with anxiety. The correla-

tions with submissiveness and stubbornness have already been mentioned, and there was also a negative correlation with exhibitionism (Table 1).

2. *Mother-Child Relationships*

The relations of maternal characteristics to the anal or compulsive characteristics in the children are shown in Table 2. The rigid mothers in this study produced effects much like those found for "undemocratic" (presumably rigid) mothers in studies by others (2, 3, 4, 10, 11, 12).

The hypothesis that a child's anal character is related to the mother's rigidity is confirmed, with the correlation of $+ .59$. The separate component qualities, however, of submissiveness and stubbornness, were only insignificantly related ($+ .23$ and $+ .18$) to rigidity in the mother. The crucial hypothesis was confirmed that the overall anal character of the children showed higher correlations with the presumed cause than does either of the characteristics believed to be manifestations of anal character. Maternal rigidity also showed positive relationships, some significant and some not, with the various other anal characteristics of the children, the measurements of which were too skimpy to be regarded as individually meaningful. Besides anality, the only other quality of the child that was strongly related to maternal rigidity was passive or covert hostility.

Some other significant relationships between the anal qualities in the child and some aspects of the mother also appeared, though they were uniformly lower than the relationships of maternal rigidity.

The mother's achievement need was related ($+ .34$) to the child's anal character; i.e., the mothers with great need for achievement tended to have children with anal character.

The quality in the mother known as overprotectiveness, or selective reinforcement of dependency, was related ($+ .34$) to the child's submissiveness; i.e., the overprotective mothers tended to have submissive children. The correlation rose to an even higher level ($+ .46$) when the mother's warmth or nurturance was held constant by partial correlation.

The mother's nurturance was negatively related to the child's submissiveness (i.e., the unloving mothers tended to have submissive children). This relationship was obscured by the positive one between maternal overprotection and submissiveness, because the measures of maternal nurturance and overprotection were positively correlated to the extent of $+ .78$. It was only when the mother's overprotection was held constant by partial correlation that a strong effect of lack of maternal nurturance in making children submissive was revealed ($r = -.34$).

TABLE 2
MOTHER-CHILD RELATIONS
(a) indicates clinical ratings; (b) indicates total ratings

		(a) indicates clinical ratings; (b) indicates total ratings																		
		Mother	Child	Anal character	Stubbornness	Submissiveness	Guilt	Shame	Demandingness	Need achievement	Rebelliousness	Covert hostility	Orderliness	Rigidity	Stringiness	Obsession	Reaction formation	Paranoia	Psychosis	Phobia
Nurturance	(a)	19	20	13	25	23	33	11	34	25	04	04	29	19	27	23	14			
	(b)	22	14	06	25	22	32	09	29	27	23	00	03	25	17	27	27			
Overprotection	(a)	41	23	30	23	35	33	19	15	12	36	02	12	30	34	11	01	05		
	(b)	43	24	34	27	37	42	15	18	12	42	01	09	33	42	09	05	05		
Lack of firmness	(a)	-10	01	-23	-46	01	31	-25	09	08										
	(b)	-29	04	-19	-36	04	26	-15	14	-29	-26	06	-15	-42	-30	-18	-17	-23		
Rigidity	(a)	65	22	27	38	-02	-07	18	10	63	38	16	29	18	36	36	18	19		
	(b)	59	23	18	28	-04	-10	16	15	53	36	17	36	11	31	24	14	07		
Hostility	(a)	01	28	-13	-15	-25	23	-18	38	38	16	17	25	-28	-14	30	36	08		
	(b)	11	36	-15	-06	-28	24	-10	43	48	14	15	21	-23	-13	34	35	18		
Hostility toward child		-14	12	-19	-22	-21	21	-30	28	-01										
Hostility toward others		-00	28	-11	-29	-27	12	-15	42	-03										
Anxiety over sex		-03	15	-02	-26	-19	34	-16	24	-04										
Exhibitionism		07	11	04	-11	05	39	-07	14	15										
Hysteria	(a)	-24	-29	17	-16	24	32	01	-16	-11	-02	-38	-10	-25	-20	-07	08	21		
	(MMPI)	16	-03	23	17	00	04	21	-07	-09	14	-01	-30	22	19	-14	05	-02		
Need achievement	(b)	-09	-20	24	-05	14	33	13	-10	-19	05	-24	-29	-08	-07	-16	02	13		
	(a)	31	17	06	-02	-07	01	32	07	08	29	37	10	21	10	-21	18	-06		
Education	(b)	35	31	-13	-02	-15	03	25	11	03	05	39	12	28	-06	-18	-00	01		
	(MMPI)	40	09	24	14	-04	-12	34	-02	10	15	28	15	28	20	-24	12	-00		
Occupation		14	10	-07	-04	10	08	09	03	-10	08	-10	08	-07	-09	-16	06	06		
Feeding by breast		36	33	14	13	-03	22	35	31	25	13	39	19	23	19	-07	21	01		
Schedule of feeding		-04	-05	-11	-17	-18	-21	-07	03	-01	-28	-20	00	-19	-13	-03	29	10		
Age of beginning toilet training		20	00	07	16	-12	10	03	02	22	02	04	-03	16	02	08	26	24		
Discipline by praise & disapproval		09	30	-22	-03	09	21	-08	+1	26	-29	06	-11	-07	-39	26	03	12		
Discipline by tangible deprivation		10	10	-02																
Discipline, physical		07	-05	16	-14	17	23	-16	-10	16	08	-17	-02	09	-00	29	38	06		
Discipline by shaming		26	10	17	-08	09	-02	02	10	17	12	03	10	09	05	-07	13	05		
MMMPI scales: Re		07	05	07	-14	-21	-00	08	15	03	21	23	19	-20	03	01	-15	-13		
A		-16	-04	09	-02	05	-06	19	-28	-16	06	-30	-03	08	-07	-26	-07	-22		
R		26	10	17	-08	09	-02	02	10	17	12	03	10	09	05	-07	13	05		
Es		14	38	-29	-03	-00	15	-03	16	05	-19	33	07	20	-04	06	04	01		
Fm		15	-17	16	-02	-17	-07	21	03	13	36	16	-04	-10	29	04	-11	-05		
PaS		19	13	11	09	-03	-07	29	-00	06	18	03	15	19	12	-18	01	-05		
Ap		41	-14	24	11	05	14	13	-07	29	31	04	-14	10	18	24	13	15		

D. DISCUSSION

1. *Confirmation of a Concept of Anal Character*

The concept of anal personality, first described by Freud, has had widespread acceptance among clinicians, and especially those most influenced by psychoanalysis. But it has not been generally accepted among personality psychologists, and is not well known outside of professionals in the field.

A concept of this sort is of value if it defines a genotype (Lewin), central trait (1) or source trait (5) as contrasted with the phenotype or surface trait. If the concept of anal character is of value it is because it refers to a more basic and fundamental reality than that of a surface trait (such as stubbornness, submissiveness, orderliness, stinginess) which define the syndrome. Too often, argument and opinion based on aesthetic preference has been the only basis for regarding one concept or another as more fundamental. Such decisions, however, can better be based on quantitative evidence.

This study produces at least two lines of evidence bearing on this question. Both of them support the validity of a concept of "anal character" as the fundamental underlying source trait. The first line of evidence is the correlation with an antecedent or cause—in this case a behavior pattern in the parent: rigidity. The basic variable or source trait should correlate highly with the causal factor measured. The surface manifestations should be less highly correlated, because their relationship with the antecedent is more remote (Figure 1). The results of this study showed that the anal qualities that were measured fit these criteria. Overall ratings of anal character, as predicted, correlated more highly with the parental variable than did any of the presumed surface traits.

The second line of evidence is in the correlation with other personality characteristics. The source trait or basic personality variable should be rather unrelated to other fundamental traits. The surface trait, which is the product of several source traits, should be somewhat related to a number of them. In the results of the present study, anal character, as befits a source trait, was unrelated to dependency, aggression, and repression. Submissiveness, however, was related to all three, and stubbornness to one of these and others. The results are such as one would expect to find if anal character is the source trait or basic variable, and both submissiveness and stubbornness are surface traits resulting from anal character plus other determining factors (Figure 1).

A third possible line of evidence is in the interrelations of the anal qualities themselves; this evidence is not strong, however, because the method of scoring strongly affected the interrelationships.

In summary, the evidence presented here tends to confirm the existence of the entity known as anal character. Let us refer to Figure 1, in which Sears had suggested, in effect, that levels 4 and 5 are to be left out, and that on level 3, toilet training should be replaced by a variety of specific trainings of habits. The results of the present study suggest that level 5, the concept of anal character, should be retained as a causal link. The evidence presented here does not bear on the question whether level 4 need be retained, nor on the question of modification of level 3.

2. *Correlates of Submissiveness*

Submissiveness was clearly related to other processes besides those known as anal character. It showed significant relationships with the "oral" qualities (i.e., the dependent, anxious, pessimistic, and passively resentful children tended to be submissive). It also had a significant relationship with repression or hysterical character. The positive relationship with conscience is difficult to evaluate, as it is plausible that a merely submissive child may be giving credit for more conscience development than he has, since he is well-behaved and unaggressive. It is plausible to suppose that the lack of aggression and the apparent high conscience level are the consequents of submissiveness, while the correlations with the oral qualities, anal character, and hysterical character (repression) show the antecedents or causes of submission. In other words, submissiveness is a surface trait resulting from three source traits, orality (dependency-anxiety-pessimism-passive hostility), anal character (reaction formation), and hysterical character (repression); and in addition, negatively related to oral aggression.

Another interesting finding concerned a maternal cause of children's submissiveness. Here one must examine the relationship with two maternal qualities, (a) nurturance or love and (b) overprotection or selective rewarding of the child's dependency. The previous studies on the same mothers (7) showed that these two characteristics, as rated, were correlated highly and in such a way as to obscure their opposite effects on some characteristics of the children; only when each influence was separated from the other by partial correlation did some clear-cut effects appear. The same consideration applied in part to the effect on children's submissiveness. A lack of affection or nurturance from the mothers was associated with submissiveness in the children. The effect appeared only when maternal overprotection was held constant. This relationship is further reason for including submissiveness among the "oral" characteristics.

The other maternal influence on submissiveness, *viz.*, overprotection, was

of quite a different nature. A group of behavior ratings in the mother were chosen to measure her tendency to reward the child's dependent behavior selectively, as compared with his self-reliant actions. This quality seems to be much the same as that described by Levy (9) as "overprotection." Maternal overprotection could be shown to make the children submissive, and the effect appeared most strongly when the maternal nurturance was held constant statistically. In this respect, too, the maternal effects on submissiveness resembled those on dependency. It seems that the mothers who encouraged dependency are the same ones who encouraged submissiveness in their children.

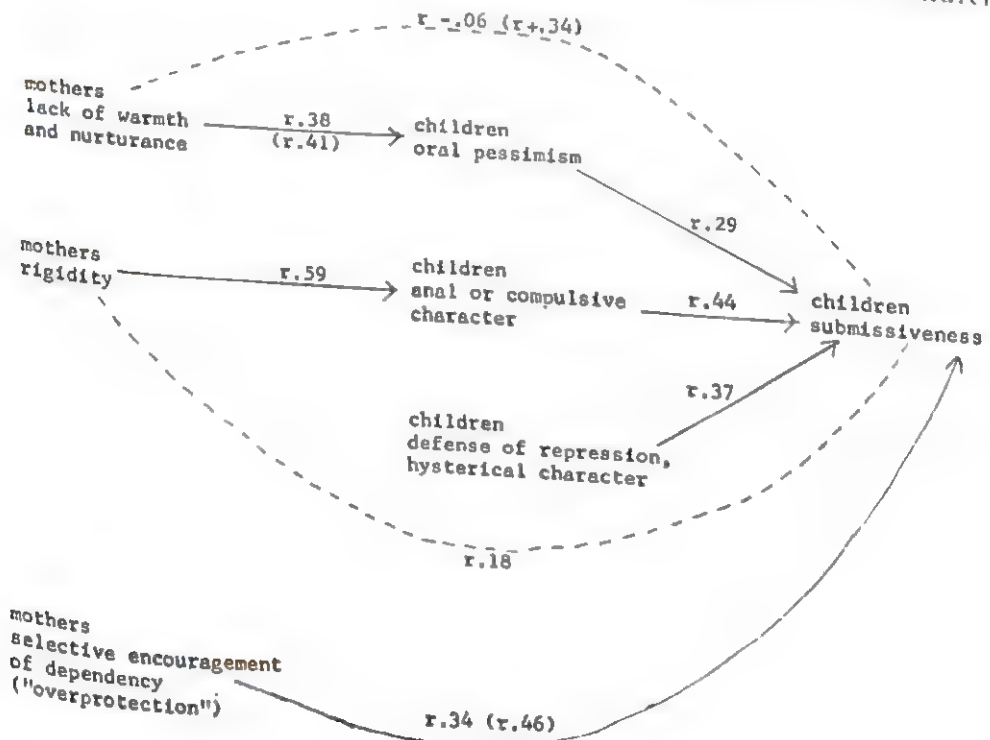


FIGURE 2
CAUSAL CHAIN FOR SUBMISSIVENESS

Figures in parentheses are partial correlations of nurturance, holding overprotection constant, or overprotection, holding nurturance constant.

It may be that this maternal behavior quality is best described as a selective reward of the child's submissive behavior. This influence on submissiveness seems to be an instance of direct buildup of a behavior tendency by encouragement and reward, a process described by Hull as "reinforcement." Submissiveness of this origin may depend on quite a different process from the submissiveness related to anal character and maternal rigidity.

The causal relationships of submissiveness are shown in Figure 2. Several different underlying causes of this surface trait are shown. The magnitude of the correlations is such that the relationship of submissiveness with maternal rigidity can be accounted for entirely through the link with anal character. In contrast is the causal system of covert or passive hostility, which involves some of the same causal variables (Figure 3). The relationship of covert hostil-

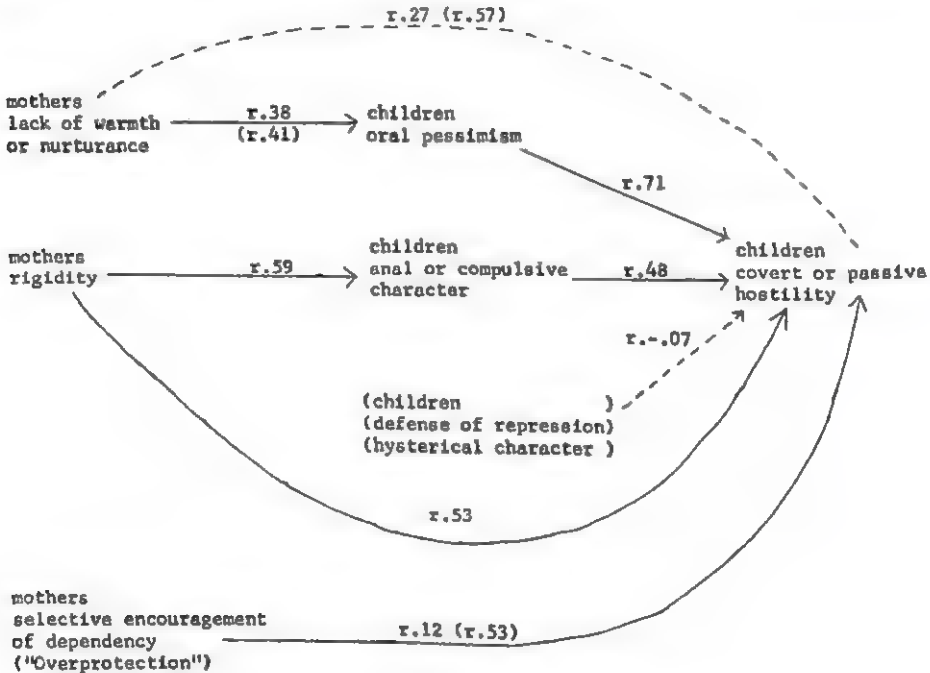


FIGURE 3
CAUSAL CHAIN FOR COVERT PASSIVE HOSTILITY

Figures in parentheses are partial correlations of nurturance, holding overprotection constant, or overprotection, holding nurturance constant.

ity with maternal rigidity is such that it cannot be accounted for entirely through the link with anal character, but an additional connection must be postulated.

3. Correlates of Stubbornness

The ratings of stubbornness showed high correlation with one area outside the "anal" field. These were with rebelliousness, demandingness, and aggression, a complex that can be categorized as "oral aggression." In the opinion of the author, this apparent relationship results from poor wording or poor selection of the items used, such that the ratings on stubbornness contained a

large measure of rebelliousness. In future studies, one would recommend trying to obtain purer measures of stubbornness, less highly related to rebellion.

4. *Correlates of Anal Character in the Child*

Most of the qualities in the children correlated with anal character are those that are generally considered to be part of the anality or compulsivity syndrome, including orderliness, rigidity, reaction formation, and obsessiveness. The relationships with guilt feeling and with conscience development raise some theoretical questions. Guilt feeling is an intermediate variable, being more highly related both to anality and to conscience development than the latter two qualities are to each other. There are many unsolved problems about guilt feeling and the development of conscience. It may be that anal character, with its reaction formation, is a stage in the development of conscience; or that it is a parallel process which mimics or resembles conscience development. It has not even been clearly established whether the guilt-ridden person is one who has a stronger conscience, a weaker conscience, or merely a different kind of conscience, from that of the healthy "normal" person.

The other behavior pattern related to anal character was covert or passive hostility. This concept referred to conscious resentment expressed in any way other than by overt active aggression. Its spectrum of behaviors included sullen sulking, having feelings easily hurt, and getting "picked on" by other children. Passive hostility has been shown (7) to be related to dependency, anxiety, and oral pessimism, and hence was included in the oral syndrome. Its strong relationship with lack of maternal nurturance was further justification for including it with the oral traits. The present study, however, showed two evidences linking passive hostility with the anal character. One was its correlation (+.48) with measures of anal character itself. The other was its correlation (+.53) with maternal rigidity, which the present study revealed as its chief antecedent cause of children's anal character. The other three "oral" characteristics did not show either of these relationships. From the evidence, covert or passive hostility must be considered as a type of behavior belonging to both the oral and the anal syndromes.

E. SUMMARY

Thirty-one boys seen at a Child Guidance Clinic were rated on anal character, and also on stubbornness and submissiveness, two of the attributes of that syndrome. The ratings on anal character took reaction formation into account by scoring both extremely high and extremely low ratings on

certain items as anal. This group of boys and their mothers had been studied in previous research, and so the correlations could be computed with eight other personality variables within the boys, and with seven attitudes or behavior patterns of their mothers. The hypothesis was confirmed that these three characteristics of the children were associated with rigidity in their mothers. The maternal antecedent was more strongly associated with the child's rating on the total anal syndrome than with either of the single attributes measured—a result which confirms the usefulness of the concept of an anal character syndrome.

Submissiveness appeared to be a type of behavior produced by several different causes, hence a surface trait rather than a basic personality variable. It was associated not only with anal character, but also with the oral syndrome (dependency and anxiety) and with the hysterical defense, repression. Submissive children tended strongly to have "overprotective" mothers who encouraged their children's dependent as well as submissive behavior. They also tended to have unloving mothers. Since the "overprotective" mothers tended to be rated as loving, the latter two effects obscured each other and were shown more clearly when the effect of each maternal variable was computed with the other held constant.

The behavior known as passive or covert hostility was related to both the oral and anal syndromes. Similarly, it was related to the qualities in the mothers that produce each of these syndromes: lack of affection, "overprotection," and rigidity.

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SOME COMPARISONS OF NORMAL AND IRRADIATED MONKEYS ON BETWEEN-DAY REVERSAL LEARNING*¹

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A. PURPOSE

Warren, Kaplan, and Greenwood (3) studied the effects of sublethal whole-body neutron and gamma radiation on the capacity of the monkey to solve discrimination-reversal problems. Testing included training and reversal testing on each of a series of 108 discrimination problems. Each reversal test was 10 trials in length. Their normal and irradiated groups did not differ significantly on prereversal training, but the Ss of their irradiated groups had significantly more errors than the control Ss on the postreversal training.

More recently, McDowell and Brown (2) have, similarly, studied the effects of sublethal whole-body neutron and gamma radiation on the capacity of the monkey to solve an oddity-reversal problem. Testing involved a single problem, but both training and reversal testing were to a high criterion of achievement. During training, each S was tested 24 trials per day to the criterion of two successive days with two or less errors per day on response to that one of three objects which was odd in color. During reversal training, each S was tested to the same criterion on response to that one of the same three objects which was odd in form. No consistent differences were observed in the number of errors made by the normal and irradiated Ss to reach either the pre- or postreversal criterion, but the irradiated Ss did show significantly smaller negative savings scores than the normal Ss.

The present study was undertaken to compare the learning performance of normal and whole-body irradiated monkeys on successive reversals of the same discrimination problem. Each reversal involved testing to a relatively high criterion of achievement, but one less stringent than that previously used by McDowell and Brown.

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B. MATERIALS AND METHODS

1. Subjects

Twenty male rhesus monkeys were used as Ss. These Ss, the survivors of an earlier comprehensive study of behavioral effects of whole-body exposure to radiation (1), were grouped into three subgroups: a control group of four Ss, a low-dose group of six Ss, and a high-dose group of 10 Ss. The dose range for the Ss in the low-dose group was between 10 to 16 neutron rep plus 70 to 140 gamma roentgens, and the dose range received by the Ss in the high-dose group was between 27 to 54 neutron rep plus 284 to 557 gamma roentgens, the source including both gamma and neutron radiation. The chronic exposure of the experimental Ss to radiation preceded the present study by approximately six-and-one-half years.

2. Apparatus

All training of Ss in this experiment was conducted in a modified version of the Wisconsin General Test Apparatus, with the animal transport cage serving as the holding cage during the test procedure. A stimulus tray holding two food wells, spaced 12 inches apart, center-to-center, was used. The two stimulus objects, used for all of the testing, differed in multiple dimensions.

3. Procedure

On the first day of training each S was tested to the criterion of 10 successive responses to Object A, on the second day to the criterion of 10 successive responses to Object B, on the third day to the criterion of 10 successive responses to Object A, *et cetera*, for 10 days of training.

Dependent variables used to compare learning performance of the normal and irradiated Ss during the nine days of reversal training included errors to initial correct response, errors to criterion, and trials to criterion. Each comparison was made over successive three-day periods of reversal training and utilized a groups-by-time analysis of variance procedure.

C. RESULTS

Figure 1 shows the mean errors to initial correct response over all reversal training for the Ss of each of the three groups. Statistical analysis over successive three-day periods of reversal training with respect to this variable yielded a difference between groups which was beyond the .005 significance level, but no other significant *F* ratios. Errors to initial correct response, as can be seen in Figure 1, were directly related to previous relative radiation dosage.

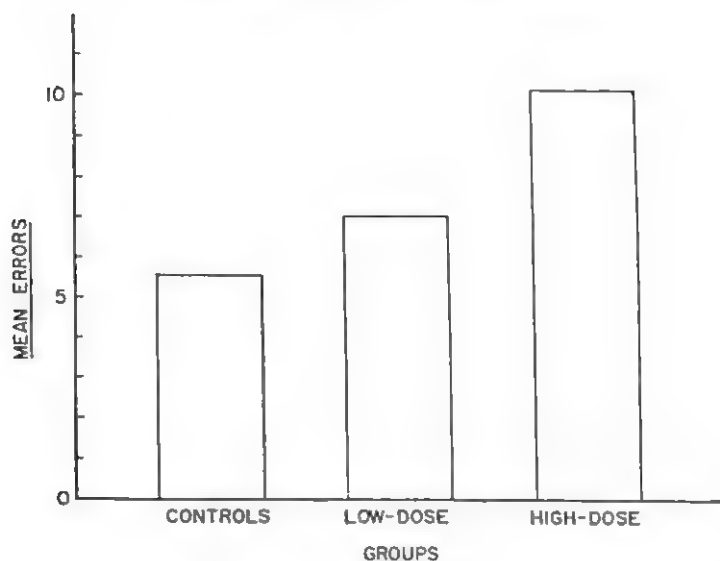


FIGURE 1
MEAN ERRORS TO INITIAL CORRECT RESPONSE FOR THE *SS* OF THE CONTROL, LOW-DOSE, AND HIGH-DOSE GROUPS DURING THE NINE DAYS OF SUCCESSIVE REVERSAL TRAINING

The statistical analyses involving errors to criterion and trials to criterion yielded no significant *F* ratios. The groups, in other words, failed to differ significantly with respect to reversal learning to a stable criterion of achievement.

D. DISCUSSION

The findings of the present study are equivocal. One can interpret the greater frequency of errors to initial correct response for the irradiated *SS* as a reflection of decreased capacity to solve successive discrimination-reversal problems. If, however, one considers that it is inappropriate to include first-trial errors in any evaluation of reversal learning, that the average frequency of errors to initial correct response for the *SS* of the high-dose group is only slightly greater than one per day, and that the distribution of errors to initial correct response is stable over days of testing, one can interpret the greater frequency of errors to initial correct response for the irradiated *SS* as a reflection of increased capacity for retention between days of training. If one further considers that, in spite of significant differences in errors to initial correct response, the groups fail to differ significantly in the achievement of a stable criterion of learning during reversal training, the second interpretation appears even more plausible and is the one accepted by the authors.

E. SUMMARY

Four normal, six low-dose irradiated, and 10 high-dose irradiated male rhesus monkeys were tested for 10 days on a two-object discrimination problem with the valences of the objects held constant within each day of testing, but alternated between successive days of testing. Each S was tested each day to the criterion of 10 successive responses to the object holding the positive valence for the day. Statistical analyses of the data over successive three-day periods of the nine days of reversal training yielded the following results:

1. The difference between radiation groups with respect to errors to initial correct response was beyond the .005 significance level. The frequency of occurrence of this variable, as well as the difference between groups, was stable over time. Errors to initial correct response varied directly with previous relative radiation dosage.

2. The radiation groups failed to differ significantly with respect to the achievement of a stable criterion of learning during reversal training, both in terms of errors to criterion and trials to criterion.

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SEX AS A FACTOR IN AMBIVALENT CUE, DELAYED-
RESPONSE PERFORMANCE BY RHESUS MONKEYS*¹

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A. PURPOSE

McDowell, Brown, and McTee (1) found female rhesus monkeys to be superior to male rhesus monkeys on identical cue, spatial delayed-response learning and attributed the superiority of the female monkeys to their greater attentiveness, as experimentally demonstrated, rather than to a sex difference in "intellectual" ability. More recently, McDowell, Brown, and McTee (2) have demonstrated the replicability of these results with an independent group of monkeys and have shown, in addition, the superiority of female monkeys on reduced-cue discrimination problems, problems incorporating elements of both object-quality discrimination and delayed-response performance.

The purpose of the present study was to compare the performances of male and female rhesus monkeys, with previous training on identical cue, spatial delayed-response problems, on spatial delayed-problems with ambivalent cues.

B. MATERIALS AND METHODS

1. *Subjects*

Sixty-four rhesus monkeys, ranging in age from 36 to 48 months, were employed as Ss. Fifty-six of the Ss had been exposed to nuclear radiations at the Nevada Test Site approximately 18 months before the present investigation was initiated. The number of Ss of each sex in each subgroup and the radiation dosages for the Ss of each subgroup are shown in Table 1. Following the precedent established in previous studies with the same Ss (2, 3), the Ss of the control group and of radiation subgroups I and J constituted Radiation Group 1, the Ss of radiation subgroups F, G, and H constituted Radiation Group 2, and the Ss of radiation subgroups C, D, and E constituted Radiation Group 3. All Ss had experienced previous training on identical

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cue, spatial delayed-response problems and on discrimination problems with reduced stimulus cues (2).

2. Apparatus

All training of *Ss* in this investigation was conducted in a modified version of the Wisconsin General Test Apparatus (WGTA), the holding cage of which measured 36 by 30 by 24 inches. A stimulus tray holding two food

TABLE 1
DOSE LEVELS FOR AND NUMBER OF *Ss* OF EACH SEX IN EACH SUBGROUP

Subgroup	Gamma (r)	Neutron (Rep)	Estimated total dosage (rem)	No. of males	No. of females
C	252	209	670	5	1
D	242	183	608	4	1
E	204	154	512	5	3
F	187	126	439	3	4
G	169	114	397	5	3
H	151	102	355	3	4
I	129	85	299	6	2
J	119	77	273	5	2
Control	0	0	0	3	5
Total				39	25

wells, spaced 12 inches apart, center-to-center, was used. The two stimulus objects for ambivalent cue, delayed-response testing were selected from the laboratory stock of discrimination test objects and differed in multiple dimensions.

3. Procedure

Each *S* was tested on 24 problems per day for 15 days. Over the course of the 24 daily problems, rewarded position was aperiodically, but evenly, varied between the left and right positions. Each test object, however, retained a constant position throughout the 15 days of testing.

A 10-second ambivalent cue, delayed-response trial was presented in the following manner. With the opaque screen of the WGTA raised, the attention of the *S* was drawn to the food reward and the food reward was placed in either the right or left food well according to a predetermined order. The dissimilar stimulus objects were then placed simultaneously over the two food wells. After a 10-second delay, the stimulus tray carrier was advanced and the *S* was allowed to make a choice. After the *S* completed the first trial, the stimulus tray carrier was withdrawn and the second trial commenced. The *S* was allowed only one choice on each trial.

C. RESULTS

Statistical analysis of the error data, using a nonorthogonal analysis of variance procedure, failed to yield significant results for the radiation variable, but gave a practice effect which was beyond the .001 significance level and a sex-by-practice interaction which was beyond the .025 significance level. Figure 1, which shows the mean errors for each sex on successive five-day periods of ambivalent cue, delayed-response training, indicates the nature of

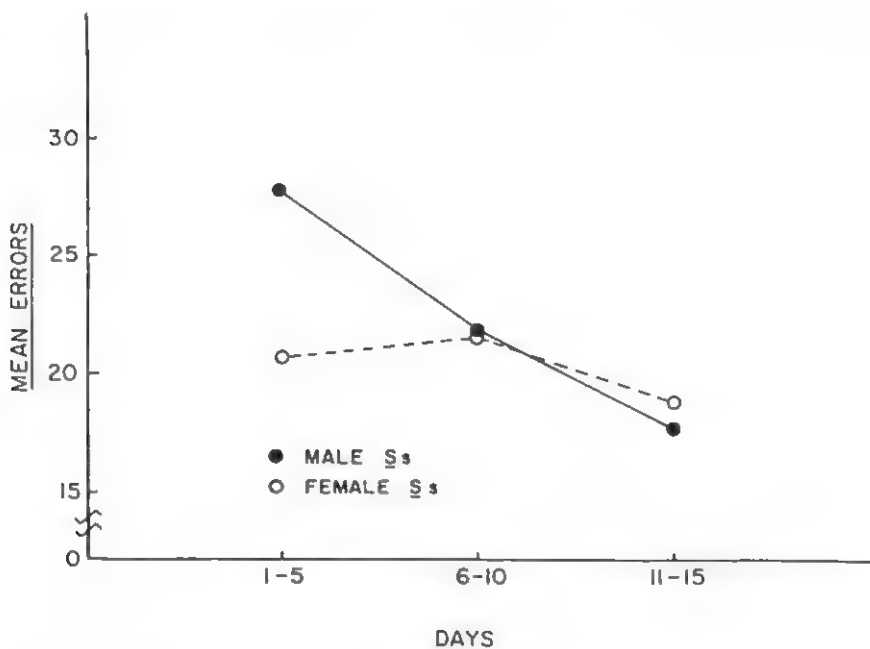


FIGURE 1
MEAN ERRORS FOR EACH SEX ON SUCCESSIVE FIVE-DAY PERIODS OF AMBIVALENT CUE,
SPATIAL DELAYED-RESPONSE TRAINING

the sex-by-practice interaction. The performance of the female Ss is immediately almost asymptotic and initially superior to that of the male Ss. The performances of the male and female Ss are virtually equivalent for the second and third periods of practice.

D. DISCUSSION

The results of the present study provide another instance of facilitation of performance by sex as an inherent independent variable. The performance of female monkeys, with previous training on identical cue, spatial delayed-response, was immediately almost asymptotic on ambivalent cue, spatial de-

layed-response, while the performance of male monkeys with similar previous training only gradually improved to the level of proficiency shown by the female Ss. It is the interpretation of the authors that increased concentration of attention of the female Ss decreased the probability of response to the negative cue during each period of delay and, in consequence, reduced the ambivalent character of problem solution. The male Ss, on the other hand, with their greater tendency to shift attention, apparently had to learn to make trial discrete stimulus cue responses.

E. SUMMARY

Thirty-nine male and 25 female rhesus monkeys, ranging in age from 36 to 48 months, that had previously been exposed to varying dosages of nuclear radiations, were compared with respect to learning performance on ambivalent cue, spatial delayed-response. All Ss had been trained previously on identical cue, spatial delayed-response. Statistical analysis of the error data, using a nonorthogonal analysis of variance procedure, yielded a practice effect which was beyond the .001 significance level and a sex-by-practice interaction which was beyond the .025 significance level. Performance of the female Ss was immediately almost asymptotic and initially superior to that of the male Ss. The performance of the male Ss gradually improved to the level shown by the female Ss.

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BOOKS

Now that there is a special APA journal completely devoted to the publication of book reviews, it is no longer necessary that other journals emphasize such publication. It has always been our conviction that book reviews are a secondary order of publication unless they carry information that is as equally important as the book. However, the publication of book titles is a very important service, and we shall continue to render that service.

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